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1986 NETWORK REVIEW

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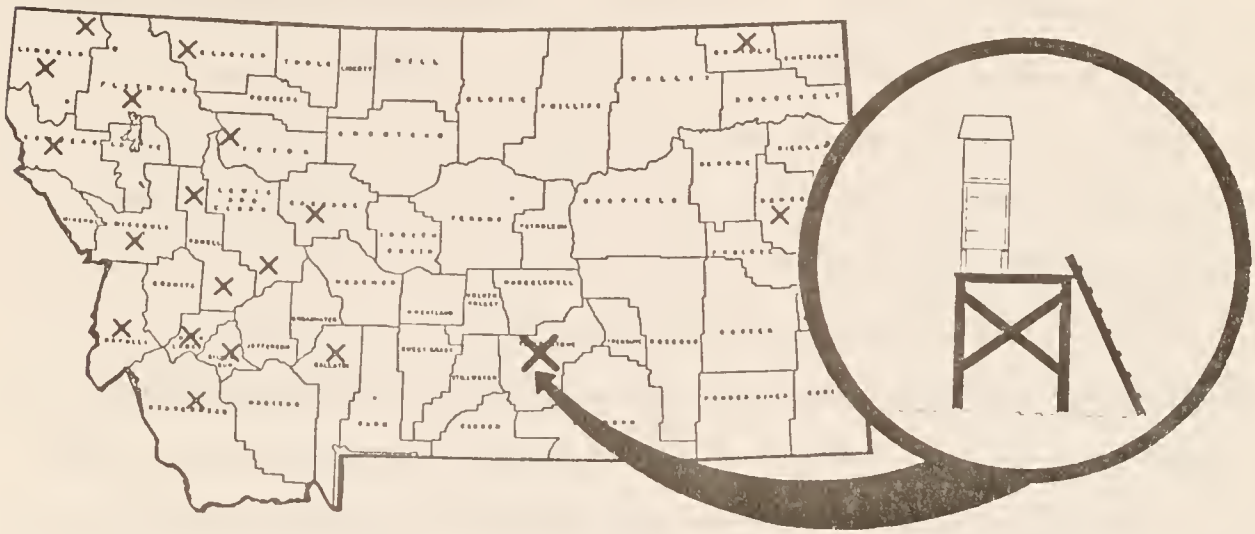
INTRODUCTION



The U. S. Environmental Protection Agency (EPA) requires the Montana Department of Health and Environmental Sciences (DHES) to conduct an annual review of the state's ambient air monitoring network. This report is the eighth in the series. EPA's requirements, as set forth in 40 CFR 58.20, are (1) to determine if the system meets the monitoring objectives defined in Appendix B of 40 CFR 58.20, and (2) to identify needed modifications of the network, such as termination or relocation of unnecessary stations or establishment of new stations that may be necessary. The department is required by 40 CFR 58.25 to develop and implement an annual schedule modifying the network in order to eliminate any unnecessary stations or to correct any inadequacies indicated by the results of the annual review. The department must consult with the Regional Administrator of the EPA during

the development of the schedule to modify the monitoring program. The final schedule and modifications are subject to the approval of the Regional Administrator.

In order to conduct this review, the monitoring objective and spatial scale of representativeness of each station, existing or proposed, are first examined to determine whether they represent the air quality situation of the area. Background information, such as maps, climatological summaries, emission inventories, traffic counts, and modeling results, are gathered and reviewed. The opinions of the department staff, the personnel of four county air pollution agencies, as well as several other county health agencies, and staff members of the Helena EPA office also are solicited.

In the 1979 Network Review, the department designated each monitoring site in the state as either National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS), or Special Purpose Monitoring Stations (SPM). The NAMS/SLAMS network is designed to meet four basic monitoring objectives: (1) to determine the highest concentrations expected to occur in the area covered by the network (concentration); (2) to determine representative concentrations in areas of high population density (population); (3) to determine the impact on ambient pollution levels of significant sources or source categories (source); and (4) to determine general background concentration levels (background). Each station in the NAMS/SLAMS network also is sited so that the air sampled is representative of certain spatial scales, which are defined as follows:

Microscale: defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.

Middle Scale: defines the concentrations typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometers.

Neighborhood Scale: defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range.

Urban Scale: defines the overall city-wide conditions with dimensions on the order of 4 to 50 kilometers. This scale usually requires more than one site for definition.

Regional Scale: usually defines a rural area of reasonably homogeneous geography and extends from tens to hundreds of kilometers.

National and Global Scales: these measurement scales represent concentrations characterizing the nation and the globe as a whole.

In order to site a monitoring station properly, both the monitoring objective and the spatial scale of representativeness must be determined. Appropriate siting scales for the various monitoring objectives are listed in Table 1.

TABLE 1

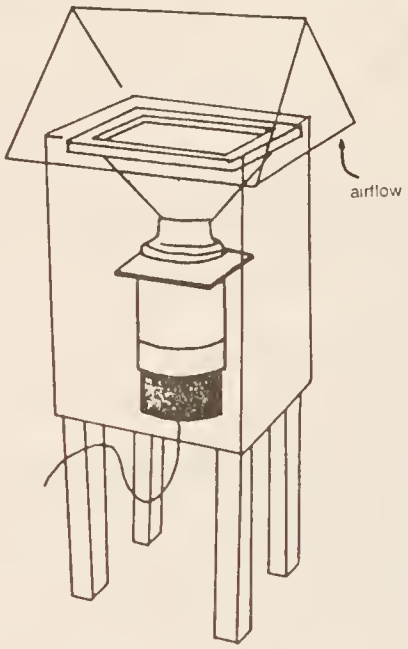
MONITORING OBJECTIVES AND APPROPRIATE SITING SCALES

Monitoring Objective	Siting Scales
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
Background	Neighborhood, regional

The goal in siting stations is to match correctly the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for each station's monitoring objective. During the process of the first network review in 1979, existing stations were evaluated for their monitoring objective and siting scale and, when necessary, were modified. New stations established since then have been sited in accordance with the monitoring objective and siting scale determined in advance.

The department developed this network review as a supplement to the comprehensive 1985 Network Review. The department intends to perform a comprehensive review every two years.

Total Suspended Particulates



TSP is the most common pollutant in Montana and affects the entire state. The major sources of particulates are residential wood burning, industrial activity, coal mines, traffic on paved and unpaved roads, and agricultural activity. Table 2 lists the particulate emissions from the major industrial sources throughout Montana. The highest particulate concentrations in Montana are found in urban areas such as Billings, Bozeman, Butte, Helena, Kalispell, and Missoula, or smaller towns in western Montana such as Columbia Falls, Libby, Eureka, and Thompson Falls. Particularly in the western valleys, winter inversions allow particulate levels to increase and to remain high for days or weeks at a time. Some rural areas also show high particulate levels, due primarily to agricultural activities and unpaved roads.

TABLE 2

POINT SOURCE PARTICULATE EMISSION ESTIMATES FOR 1985

Source	Part. Tons/Yr	County	City
Exxon Co. USA	1423	Yellowstone	Billings
Continental Oil Co.	320	Yellowstone	Billings
Montana Power Co. (Corette)	578	Yellowstone	Billings
East Decker Coal	* 910	Big Horn	Decker
Westmoreland Resources	* 601	Big Horn	Hardin
Cenex	643	Yellowstone	Billings
West Decker Coal	* 744	Bighorn	Decker
Spring Creek Coal	* 291	Bighorn	Decker
Western Sugar	2369	Yellowstone	Billings
Bighorn Calcium	* 284	Carbon	Warren
Cereal Food Processors	206	Yellowstone	Billings
Spring Creek Forest Products	* 53	Wheatland	Judith Gap
Kaiser Cement	*1495	Jefferson	Montana City
ASARCO Smelter	734	Lewis&Clark	East Helena
Ideal Basic Industries	* 154	Gallatin	Trident
Stauffer Chemical Co.	941	Silver Bow	Ramsay
Pfizer Talc	408	Beaverhead	Dillon
Cyprus Ind. Minerals-Yell.Mine	* 856	Gallatin	Three Forks
Louisiana Pacific Corp.	152	Powell	Deer Lodge
Cominco	* 102	Powell	Garrison
Western Energy	*2521	Rosebud	Colstrip
Montana Power Co. 1 & 2	989	Rosebud	Colstrip
Peabody Coal	* 417	Rosebud	Colstrip
Montana Dakota Utilities	426	Richland	Sidney
Holly Sugar	81	Richland	Sidney
Montana Power Colstrip #3	1160	Rosebud	Colstrip
Knife River Coal	* 97	Richland	Savage
Champion International	861	Lincoln	Libby
Missoula White Pine & Sash	* 177	Missoula	Missoula
Stone Container, Inc.	1094	Missoula	Frenchtown
Champion/Bonner	102	Missoula	Bonner
Louisiana Pacific Particleboard	705	Missoula	Missoula
Plum Creek Lumber	* 238	Lake	Pablo
Flathead Lumber	225	Lake	Polson
Plum Creek Lumber	254	Flathead	Columbia Falls
Plum Creek Lumber	90	Flathead	Evergreen
Flodin Lumber	* 53	Sanders	Thompson Falls
W. I. Forest Prod. Inc.	* 75	Sanders	Thompson Falls
American Timber	* 159	Flathead	Olney
Stoltze Land & Lumber	* 232	Flathead	Columbia Falls
W. R. Grace Co.	271	Lincoln	Libby
Pyramid Mountain Lumber	* 64	Missoula	Seeley Lake
Champion Int./Intermountain	76	Missoula	Missoula
Plum Creek/Fortine	* 86	Lincoln	Fortine
ASARCO-Troy	* 190	Lincoln	Troy

*Fugitive emissions associated with mining and vehicle traffic are included.

All of Montana's TSP monitors are sited according to the middle, neighborhood or regional scale (see Table 35). Selection of the appropriate siting scale is dependent on the station's monitoring objective. The monitoring objective for most stations is "population." All of the "population" stations are sited according to the "neighborhood" scale, which corresponds to areas with dimensions from 0.5 to 4.0 kilometers.

For those stations designed to determine the impact of particulate sources on ambient concentrations, the monitoring objective is "source." Most of the particulate monitoring around air pollution sources is conducted by the companies responsible for the emissions. The department receives data from company sites and conducts periodic audits of the sites and data. All "source" stations are sited according to the "neighborhood" scale with the exception of the Border and Hanrahan sites near Scobey, which are scaled regionally, and the Anaconda Wolfe Residence and Wheels and Deals sites which are considered middle scale.

Several stations in urban areas are designed to monitor areas of highest concentration, and are sited according to the "neighborhood" scale.

"Background" stations are chosen to determine concentrations of particulates in areas remote from man-made sources. The department recommends two background stations for Montana, one in the eastern part of the state to characterize background concentrations in the plains, and another in a western valley for the mountainous portion of the state. The site at the Terry Smith Ranch near Ovando, in Powell County, serves as the western Montana background station while Jordan, in Garfield County, comprised the eastern Montana station until May, 1984, when the operator no longer had time to operate the sampler. Both background sites were sited

according to the "regional" scale of representativeness. The department removed the site at Jordan because there were no other prospective operators within a reasonable driving distance of the site. Although the department staff considers it important to have an eastern Montana background site, we are not planning to establish a new one at this time because of inadequate funding.

On March 19, 1986, the EPA amended Appendix A of 40 CFR Part 50 to include new requirements specifying the number of TSP sites to be selected for duplicate sampling. The number of collocated sites required is based on the total number of TSP sites operated by a reporting organization. Table 3 displays these requirements.

TABLE 3

COLLOCATED SAMPLING REQUIREMENTS FOR TSP

Number of Sites Operated by a Reporting Organization	Number of Collocated Sites Required
1-5	1
6-20	2
greater than 20	3

As a result of the changes, the department is now required to operate three collocated sites, while the air pollution control agencies in Cascade, Lewis and Clark, Missoula and Yellowstone Counties are required to operate one collocated site each. To meet these requirements, the department will install an additional collocated site and, since Lewis and Clark County will be a reporting organization as of January 1, 1987, they will also need to install a collocated site.

The new requirements also specify that the sites selected for collocated sampling be among those sites with annual mean particulate concentrations in the upper 25 percent of all of the sites in the network. The department intends to establish the new collocated site at the Columbia Falls Junior High School. The department initiated PM-10 monitoring at this site in May, 1985, and TSP monitoring in October, 1985. The arithmetic mean for TSP during the last three months of 1985 and the first four months of 1986 was 90 ug/m^3. Since this site has only been in operation for a short time period, the department could not compare the annual mean with the rest of the network to assure it was among the upper 25 percent. However, the department is sure that this site will fall in the upper 25 percent, since the six-month mean was 90 ug/m^3 and the two highest twenty-four hour concentrations were 326 ug/m^3 and 256 ug/m^3. In addition, the department has a very reliable operator in Columbia Falls.

The department also operates collocated TSP monitoring sites at the Lincoln County Courthouse in Libby and the Hadfield site in East Helena. The Libby site usually records the highest TSP concentrations in Montana while the 1985 annual average concentration at the East Helena site is among the top 20 percent for all the department sites.

The department operated collocated samplers at the Taft School site in Billings until June, 1985. In June, the Yellowstone County Air Pollution Control Agency took over the site and shut down the collocated sampler. The county operates collocated samplers at the City Hall site and the additional collocated sampler was not necessary. Table 4 lists the stations where the department and the three county agencies operate collocated samplers.

TABLE 4

COLLOCATED HIGH VOLUME SAMPLERS

City	Site
Billings (DHES) (shut down - June, 1985)	Taft School (NAMS)
Billings (County)	City Hall (SLAMS)
Great Falls (County)	Downtown (NAMS)
Missoula (County)	Health Dept. Roof (SLAMS)
Missoula (County/Industry)	HW#1 (SPM)
East Helena (DHES/Industry)	Hadfield (SLAMS)
Libby (DHES)	Lincoln Co. Crths.(SLAMS)
Columbia Falls (DHES) (startup Oct., 1986)	Junior High Sch. (SLAMS)
Helena (County) (startup October, 1986)	Capital Courts (SLAMS)

Lewis and Clark County will install a collocated TSP sampler at the Capital Courts site during the fall of 1986. The Capital Courts site almost always records the highest TSP readings in the Lewis and Clark County network.

Montana's network of NAMS stations for TSP consists of two stations selected from the SLAMS network. In the past, NAMS were required in urban areas larger than 50,000 population. In Montana, only Great Falls and Billings have Standard Metropolitan Statistical Areas with populations in excess of 50,000. However, the March 19, 1986, amendments to Appendix D of 40 CFR Part 50 eliminated any NAMS requirement for urban areas less than 100,000 population. Neither Great Falls nor Billings have Standard Metropolitan Statistical Areas with populations in excess of 100,000. Although the department is not required to operate any TSP NAMS sites, at the request of Region VIII EPA, the department and the appropriate county agencies will continue to report data from the two existing NAMS sites until instructed differently. The new NAMS criteria are given in Table 5.

TABLE 5

TSP NATIONAL AIR MONITORING STATION CRITERIA[a][b]

Population Category	Concentration		
	High[c]	Medium[d]	Low[e]
Greater than 1,000,000	6-10	4-6	2-4
500,000 - 1,000,000	4-8	2-4	1-2
250,000 - 500,000	3-4	1-2	0-1
100,000 - 250,000	1-2	0-1	0

(a) Approximate number of stations per area.
(b) Selection of urban areas and the actual number of stations per area will be jointly determined by EPA and the state agency.
(c) High concentration - exceeding level of the primary NAAQS by 20 percent of more.
(d) Medium concentration - exceeding secondary NAAQS.
(e) Low concentration - less than secondary NAAQS.

The department operated a NAMS station at the Taft School in Billings until June, 1985, when Yellowstone County took over the operation of the site. The Yellowstone County Air Pollution Control Agency moved the Taft School NAMS site to the Grand Avenue School in November, 1985. They intend to operate the Grand Avenue site indefinitely and will report the data as NAMS data until instructed otherwise. The Cascade County Health Department also runs a NAMS site at the public library in downtown Great Falls and also will continue to report the data as NAMS data.

TSP COMPARISONS

1984 VERSUS 1985

The department compared the 1984 TSP data with the 1985 data and made some generalizations which are discussed in this section. The department only considered data from sites which recorded at least eight months of valid data in both 1984 and 1985. This limited the review to 39 sites, of which 29 were in western Montana and 10 were in eastern Montana.

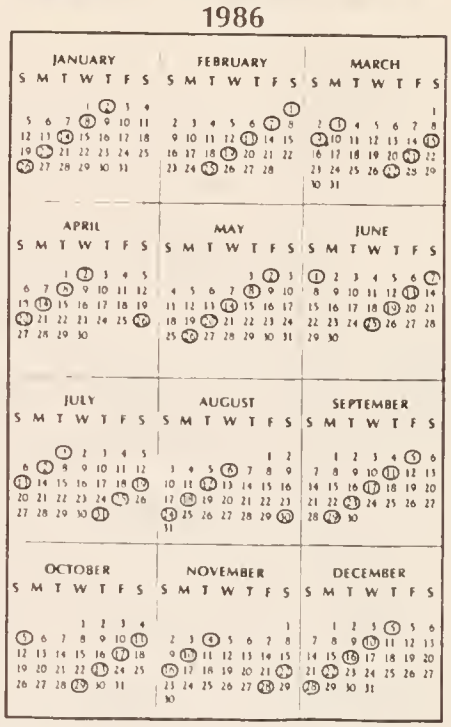
In 1985, 20 sites recorded annual geometric means which were lower than 1984, 15 sites showed increases and 4 remained the same. The average statewide change was a decrease of 1.3 ug/m^3. Although 1984 showed an increase in TSP, the 1985 data resumed a four year pattern of decreasing TSP. Most of the reduction occurred at the eastern Montana sites, which is hard to understand since the 1984 drought actually worsened during 1985.

In the mountainous portion of Montana, 13 sites registered an increase in TSP levels during 1985, 13 went down and 3 remained the same. Overall, a 0.5 ug/m^3 decrease was observed.

All but two of the eastern Montana sites remained the same or showed a decrease in TSP during 1985. The average decrease was 3.6 ug/m^3 and, as

mentioned earlier, is difficult to explain since the drought conditions worsened during 1985 and dispersion conditions are almost always good in eastern Montana.

TSP SAMPLING FREQUENCY VERSUS COMPLIANCE WITH AIR QUALITY STANDARDS



The department operates a statewide network of high volume samplers which in most cases operate on an every sixth day schedule. Data from several monitoring sites, mostly located in western Montana, indicate that TSP levels are slightly below state and federal ambient standards. The department questioned whether a more intensive monitoring schedule (every third day or daily) would result in exceedances of the standards. Therefore, the department decided to perform a statistical analysis to determine the effect of more frequent sampling.

The department chose to analyze the data from three sampling sites in Missoula and three samplings sites in East Helena. These sites were chosen since the routine every sixth day sampling frequency is a subset of the every third day and daily sampling frequencies employed in East Helena and Missoula.

The initial step in the analysis was to review the 1985 data and determine what the arithmetic mean and second highest twenty-four hour concentrations would have been if the every third day or every sixth day schedules had been followed. The second step was to establish the actual arithmetic mean and second highest twenty-four hour concentrations considering all of the data gathered at the sites during 1985 (daily schedule in Missoula and every third day in East Helena). Next the department compared the summary statistics for the various sampling frequencies. This was accomplished by dividing the arithmetic means and the second highest twenty-four hour concentrations for the daily and every third day sampling frequencies by the corresponding values for the every sixth day schedule (see Table 6). The resulting ratios provided the department with a tool to estimate the effect of more frequent sampling at other TSP monitoring sites.

The department used this tool by simply averaging the ratios for all the monitoring sites and the appropriate sampling frequencies and then multiplying the subsequent mean by the second highest 1985 twenty-four hour average for each monitoring site throughout the state. The result was a new predicted second highest twenty-four hour average for the every third day and daily sampling frequencies (see Table 7).

Prior to discussing the results the department must point out several shortcomings of this analysis. First, data from Missoula and East Helena may not be representative of the rest of Montana, especially Eastern Montana. Second, it is impossible to know whether the second highest twenty-four hour maximum concentration recorded during 1985 at each site is above or below normal. Therefore, predictions based on 1985 data may cause

over or underpredictions at individual sites, but on the average the predictions should have been quite good.

TABLE 6

COMPARISON OF ANNUAL AVERAGE AND TWENTY-FOUR HOUR TSP CONCENTRATIONS UNDER THREE DIFFERENT SAMPLING FREQUENCIES

City	Site	Sample Frequency	Arith. Mean	Ratio of Arith. Means	Average Ratio	2nd Max. 24-hour	Ratio of 2nd Max.	Average Ratio
Missoula	Rose Park	Daily	63.9			261		
		1-in-6	62.7	1.02		138	1.89	
	Boyd Park	Daily	76.6			301		
		1-in-6	76.8	1.00		177	1.70	
	Health Dept.	Daily	73.4			275		
		1-in-6	74.9	0.98	1.00	183	1.50	1.69
East Helena	Hastie Res.	1-in-3	56.1			130		
		1-in-6	56.3	1.00		111	1.17	
	Firehall	1-in-3	67.9			209		
		1-in-6	69.2	0.98		170	1.22	
	Hadfield TV	1-in-3	68.6			189		
		1-in-6	71.0	0.97		189	1.00	
Missoula	Rose Park	1-in-3	62.3			166		
		1-in-6	62.7	0.99		138	1.20	
	Boyd Park	1-in-3	76.5			177		
		1-in-6	76.8	1.00		177	1.00	
	Health Dept.	1-in-3	71.9			199		
		1-in-6	74.9	0.96	0.98	183	1.09	1.11

TABLE 7

PREDICTED TSP CONCENTRATIONS UNDER MORE FREQUENT SAMPLING SCHEDULES
AND A COMPARISON OF THE RESULTS AGAINST SIMULATED ACTUAL CONCENTRATIONS

City	Site	1985 2nd Max.	Predicted 1-in-3 2nd Max.	Actual 2nd Max. Last 2 Yrs.	Actual Minus Predicted	Predicted Daily 2nd Max.	Actual 2nd Max. Last 6 Yrs.	Actual Minus Predicted
Billings	City Hall	135	150[b]	143	-7	228[a,b]	176	-52
Billings	Grand Ave.	165	183	165	-18	279[a,c]	214	-65
Billings	Lockwood Park	133	148	153	+5	225[a,b]	---	---
Billings	Sandstone Sch.	92	102	96	-6	155[b]	---	---
Laurel	Jr. High	91	101	97	-4	154[b]	179	+25
G.Falls	Firestation	225	250	225	-25	380[c]	264	-116
G.Falls	Downtown	125	139	125	-14	211[a,b]	169	-42
G.Falls	Black Eagle	204	226	204	-22	345[c]	216	-129
Dillon	Courthouse	97	108	97	-11	164[b]	---	---
Anaconda	Lincoln Sch.	167	185	210	+25	282[a,c]	210	-72
Anaconda	Highway Jct.	73	81	480	+399	123	---	---
Bozeman	East Main	153	170	198	+28	258[a]	265	+7
Mont. City	School	228	253	259	+6	385[c]	---	---
Helena	Cogswell Bldg.	195	216[a]	248	+32	330[a,c]	248	-82
Helena	Capital Courts	213	236	213	-23	360[c]	248	-112
E.Helena	Dartman	106	118	114	-4	179[b]	---	---
Deer Lodge	Courthouse	119	132	119	-13	201[a,b]	---	---
Ovando	Smith Ranch	95	105	145	+40	161[b]	145	-16
Butte	Greeley Sch.	308	342	308	-34	521	314	-207
Sidney	Downtown	138	153[b]	166	+13	233[a,b]	---	---
Col.Falls	Anders Res.	260	289	407	+118	439	494	+55
Kalispell	Univ. Athl.	432	480	432	-48	730	432	-298
Libby	Courthouse	438	486	463	-23	740	---	---
Eureka	Lincoln Elec.	159	176	276	+100	269[a,c]	---	---
Hamilton	Courthouse	130	144	185	+41	220[a,b]	---	---
T.Falls	Courthouse	362	407	388	-19	612	---	---
					$\bar{x}$ = +20.6			$\bar{x}$ = -82.7

NOTES:

[a] A new violation of the Montana 24-hour standard.
[b] A new violation of the federal secondary 24-hour standard.
[c] A new violation of the federal primary 24-hour standard.

The results of the analysis indicated that increasing the sample frequency to every third day had essentially no impact on the annual average and caused a modest eleven percent increase in the second highest twenty-four hour average. Similarly, increasing the sampling frequency to daily sampling does not affect the annual arithmetic average. On the other hand, daily sampling increased the second highest twenty-four hour concentration by almost 70 percent.

Table 7 shows the results of using the average ratios developed in Table 6 to predict the second highest twenty-four hour averages for each site in Montana. The results indicate that increasing the frequency to every third day will result in a violation of the Montana primary standard at one additional site. In addition, violations of the federal secondary standard would occur at two additional sites. Daily sampling would result in violations of the Montana primary standard at eleven additional sites, the federal secondary standard at ten additional sites and the federal primary standard at eight additional sites.

The department reviewed the second highest twenty-four hour concentrations recorded at each site during the past two years (simulates every third day sampling) and during the past six years (simulates daily sampling), and compared the data to the predicted values in Table 7. The predicted values for the every third day sampling frequency are actually slightly below the actual data (20 ug/m^3 on the average) for the past two years. On the other hand, the predicted concentrations for the daily sampling frequency are significantly higher (83 ug/m^3 on the average) than the concentrations observed over the past six years. The department considers the latter comparison to be highly speculative since over a six year period the actual

emission sources can change significantly. The department believes the actual increase in the second highest twenty-four hour concentration due to daily sampling would be substantially less than that predicted.

The department believes that the above analysis provides sufficient evidence to warrant a more frequent sampling schedule at some TSP sites in western Montana. During September, 1986, the department intends to initiate every third day sampling at the Eureka, Lincoln Electric Cooperative site; the Butte, Greeley School site; the Bozeman, East Main site; and the Columbia Falls, Junior High School site. The department also plans to increase the sampling at the Kalispell Universal Athletics site to every third day after the conclusion of the Kalispell CMB Study.

NORTHWEST

MONTANA

Northwest Montana includes Flathead, Lake, Lincoln, Mineral and Sanders Counties. This part of Montana is very mountainous and heavily forested. The valleys of northwestern Montana probably have the poorest atmospheric dispersion conditions of anywhere in the state.

The Flathead and Mission Valleys are prominent physical features in northwest Montana. Both valleys are part of the Rocky Mountain Trench which runs north and south from northern British Columbia to Darby, Montana. The two valleys are separated by the 28-mile-long Flathead Lake. The valley floors lie approximately 3000 feet above sea level with the 9000 foot high Swan and Mission Ranges immediately to the east. The mountains to the west are significantly lower (5000-6000 feet) and more gentle. Both valleys are 10 to 20 miles wide. In light of the high TSP concentrations recorded in this area, the department will continue to expand particulate monitoring in northwest Montana.

Libby

1. Libby is a small town of 3300 people lying along the Kootenai River in extreme northwestern Montana. The Kootenai Valley runs approximately east and west in the vicinity of Libby with lesser valleys extending north and south along Pipe Creek and Libby Creek.
2. Libby probably has the worst ventilation of any community in Montana. During the winter, winds are almost always calm or very light. In the fall, the department releases and tracks pilot balloons with temperature mini-sondes as part of the Montana Smoke Management Plan. The objective is to determine surface winds, upper level winds and temperatures for dispersion forecasting. The data from the Libby release site was summarized in the 1983 Network Review and essentially reinforces the fact that Libby winds are very light and temperature inversions are common.
3. The department operated collocated high volume samplers at the Lincoln County Courthouse in the town of Libby during 1985. Figure 1 is a map of Libby indicating the site location. Table 8 summarizes the associated TSP data. Until August, 1985, the department operated a high volume sampler at the Brown Residence located in a residential area one-half block off U.S. Highway 2 and across the highway from the Champion International sawmill and plywood plant (formerly the St. Regis Paper Co.). The Brown Residence site was shut down during August, 1985, in accordance with the 1984 Network Review. An analysis conducted for the 1984 Network Review indicated that the Lincoln County Courthouse site registers similar TSP concentrations to the Brown Residence site and better meets siting criteria.

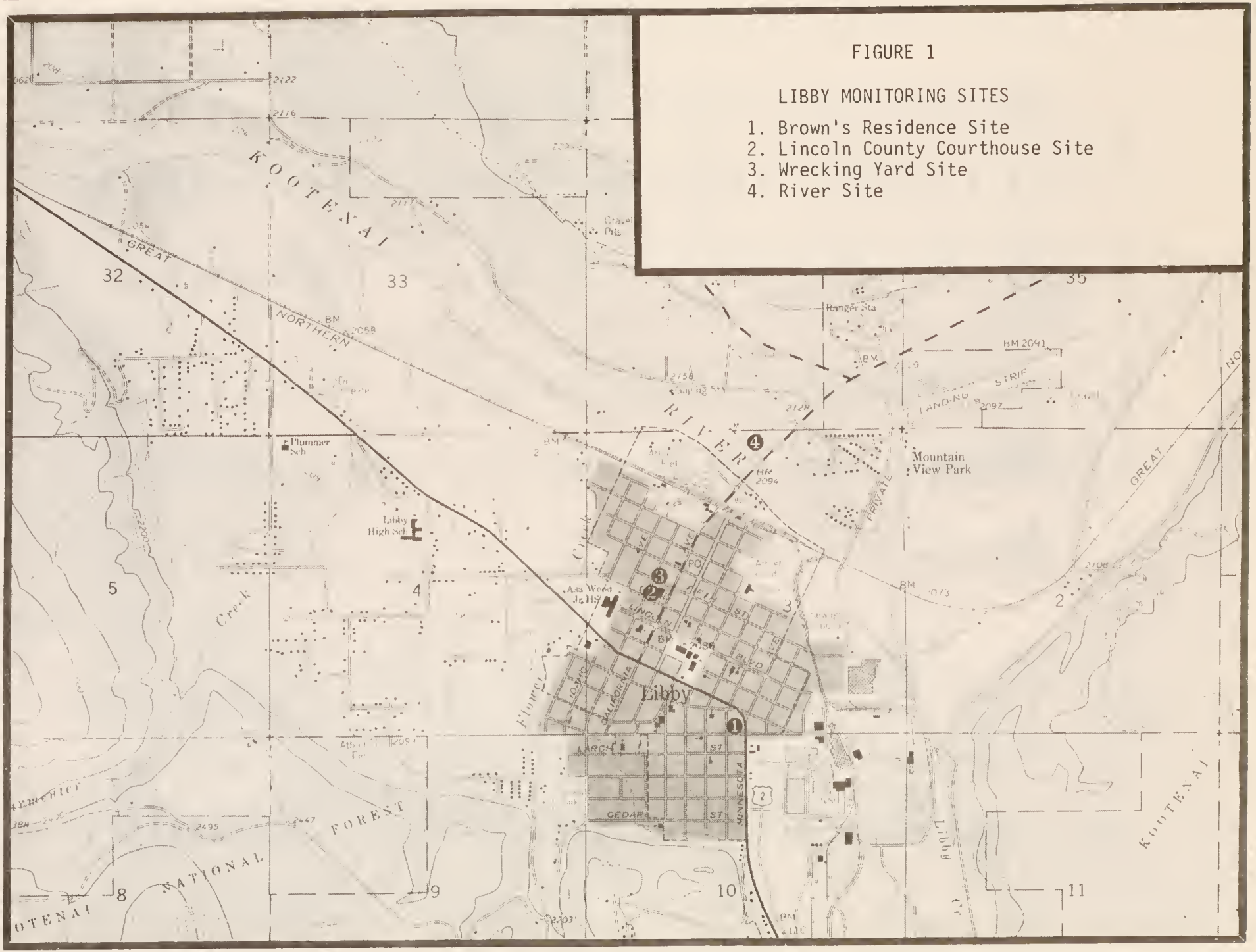


FIGURE 1
LIBBY MONITORING SITES
1. Brown's Residence Site
2. Lincoln County Courthouse Site
3. Wrecking Yard Site
4. River Site
Libby
Kootenai River
Flower Creek
Libby Creek
Great Northern
Mountain View Park
Plummer Sch
Libby High Sch
Asa Wood Jr HS
Ranger Sta
Kootenai National Forest
32
33
35
5
4
3
2
8
9
10
11

TABLE 8

SUMMARY OF TSP CONCENTRATIONS AT MONTANA SAMPLING LOCATIONS

	1984			1985		
	Geo. Mean ug/m^3	1-High ug/m^3	2-High ug/m^3	Geo. Mean ug/m^3	1-High ug/m^3	2-High ug/m^3
Libby-Brown Residence	107	378	324	115	289	288
Libby-Lincoln Co. Courthouse	103	463	364	100	642	438
Eureka-Lincoln Elec. Coop.	64*	349	276	59	190	159
Kalispell-Universal Athletics	70	209	152	79	370	210
Kalispell-Courthouse East	47	160	133	45	129	102
Col. Falls-Anders Residence	91	437	407	66	355	260
Col. Falls-Jr. High School	---	---	---	43*	151	121
Glacier Nat. Pk.-West #5	9	129	58	12	48	44
Glacier Nat. Pk.-East #8	7	71	58	8	31	30
Thompson Falls-Sanders County Courthouse	81	388	370	81	604	362
Missoula-HW #1	22	94	92	28	111	91
Missoula-HW #2	20	102	99	28	105	87
Missoula-Health Dept.	---	---	---	62	305	275
Missoula-Meadow Hills**	37	196	148	38	129	129
Missoula-Spurgin & Tower	33	147	127	38	122	110
Missoula-Rose Park	54	294	264	53	340	261
Missoula-Boyd Park	56	440	408	63	309	301
Hamilton-Ravalli Co. Cthse.	49	267	185	45	133	130
Ovando-Terry Smith Ranch	15	231	145	15	104	95
Deer Lodge-Powell Co. Cthse.	43*	109	87	42	130	119
Anaconda-Lincoln School	35	210	145	46	245	167
Anaconda-Highway Junction	30*	825	480	23	151	73
Butte-Greeley School	43	193	180	55	314	308
Dillon-Beaverhead Co. Cthse.	38*	57	54	45	112	97
Helena-Capital Courts	46	122	116	51	397	213
Helena-Cooney Home	33	98	79	30	76	69
Helena-Cogswell Building	42	248	120	46	273	195
E. Helena-Dartman Field	41	174	114	36	113	106
E. Helena-Hadfield	70	326	301	59	273	189
E. Helena-Firehall	66	216	206	59	215	207
E. Helena-Hastie	52	141	115	49	173	130
E. Helena-South	34	98	94	31	92	63
Montana City-School	78	349	201	63	259	228
Choteau-Circle 8 Ranch	---	---	---	14	41	36
Great Falls-Downtown	46	120	93	46	169	125
Great Falls-Fire Station	63	175	174	66	264	225
Great Falls-Franklin School	34*	78	70	---	---	---
Black Eagle-Post Office	56	175	134	53	225	204
Bozeman-East Main	69	198	179	56	202	153
Bozeman-Whittier School	57	202	157	57	176	150
Bozeman-Christie Fields	---	---	---	30*	62	61

	1984			1985		
	Geo. Mean ug/m^3	1-High ug/m^3	2-High ug/m^3	Geo. Mean ug/m^3	1-High ug/m^3	2-High ug/m^3
Laurel-Jr. High	37	107	92	35	97	91
Billings-Grand Avenue	58	138	106	54	237	165
Billings-City Hall	63	143	133	56	176	135
Billings-Taft School	69	191	163	63	315	208
Billings-Lockwood Park	53	187	153	52	148	133
Billings-Sandstone School	30	108	81	32	96	92
Scobey-Border	16*	54	48	21*	82	62
Scobey-Richardson	17*	114	62	19*	110	69
Scobey-Hanrahan	19*	89	84	17*	73	68
Jordan-Billings Ranch	4*	9	6	---	---	---
Sidney-Downtown	68	233	155	50	166	138
Glendive-Med. Arts Building	29	72	69	---	---	---
Plevna-BLM	32*	60	54	---	---	---

*Less than eight months of data.
**The 1985 data is for PM-15.

4. The department has conducted TSP sampling on the roof of the Lincoln County Courthouse since January, 1983. This site is the primary sampling site in Libby and was upgraded to a collocated site in July, 1984. The Courthouse site is located in the downtown area of Libby one and one-half blocks west of Main Street. The street immediately to the east of the site is Highway 37 and provides the only access to the north side of the Kootenai River. The samplers are approximately 40 feet above ground level and near the center of the block. Except for the Courthouse building itself, the remainder of the block is in lawn.

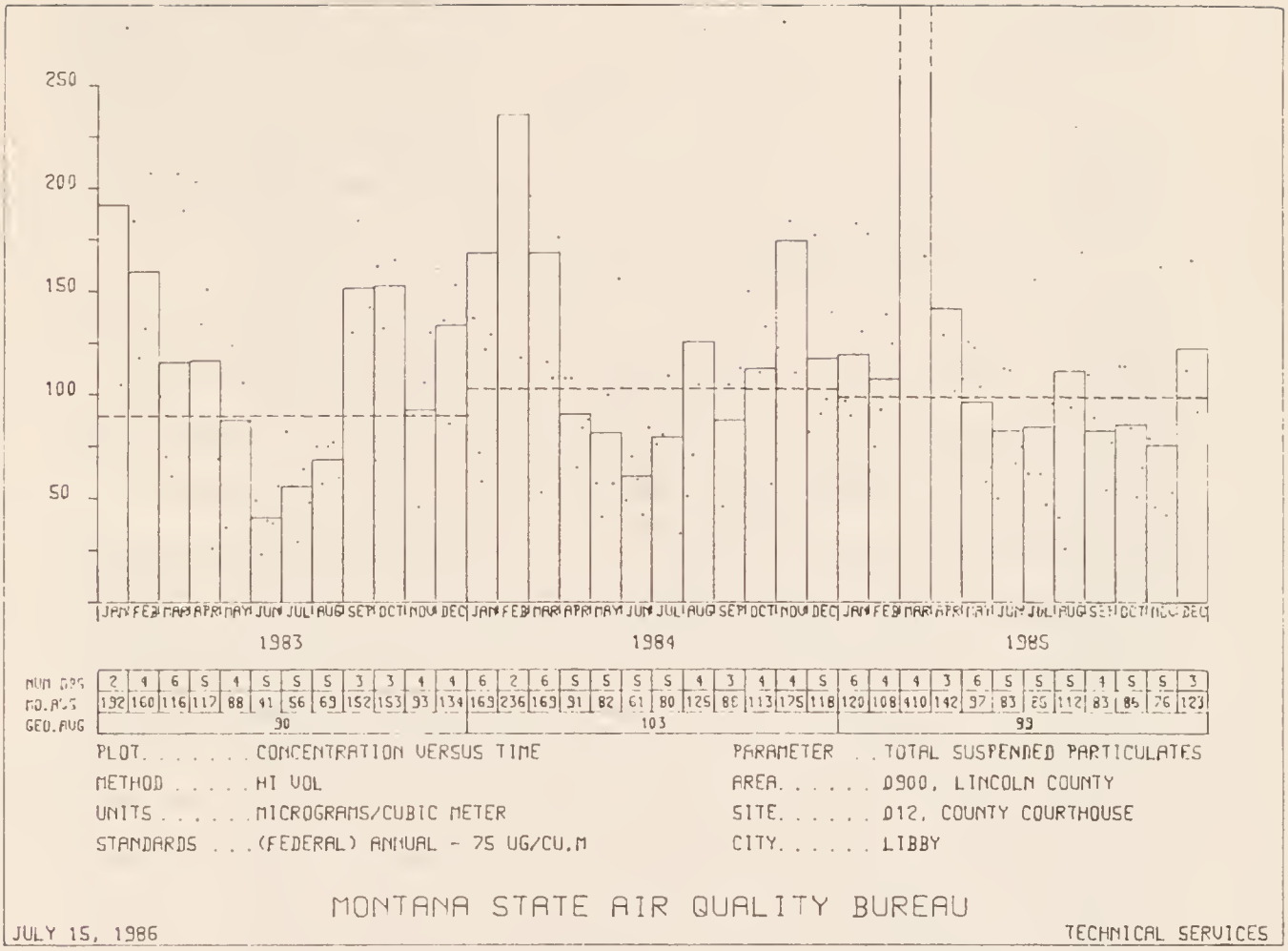
5. TSP concentrations at the Lincoln County Courthouse are very high and usually are some of the highest concentrations in the state. The Courthouse site recorded the highest annual geometric mean (100 ug/m^3) within Montana during 1985. It also recorded the highest individual concentration at 642 ug/m^3. Data from this site exceeded all Montana and federal ambient standards during 1985. Figure 2 is a three year plot of TSP data from the Courthouse Site.

6. In light of the extremely high TSP levels observed in Libby, the department initiated a special project during the winter of 1984 to better quantify the air quality and identify the major emission sources. The project was designed to achieve three objectives:

   a. To determine the source or sources of high TSP levels in Libby and the size distribution of the particles;

   b. To determine if automobile and wood stove emissions can cause elevated carbon monoxide levels in a small western Montana community; and

FIGURE 2


250
200
150
100
50
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1983
1984
1985
NUM DAYS 2 4 6 5 4 5 5 5 3 3 4 4 6 2 6 5 5 5 5 4 3 4 4 5 6 4 4 3 6 5 5 5 4 5 5 3
MO.AVG 192 160 116 117 88 41 56 69 152 153 93 134 169 236 169 91 82 61 80 125 88 113 175 118 120 108 110 142 97 83 85 112 83 85 76 123
GEO.AVG 90 103 93
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0900, LINCOLN COUNTY
SITE. . . . . 012, COUNTY COURTHOUSE
CITY. . . . . LIBBY
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

c. To identify any relationships between carbon monoxide, scattering coefficient, fine particulates, and total suspended particulates.

In order to accomplish the first objective, the department decided to utilize a receptor model known as the "Chemical Mass Balance" technique (CMB). CMB requires a multi-element chemical analysis of the emissions from the suspected sources in the study area as well as the ambient

samples collected. The elemental composition of the emissions essentially provides a source "fingerprint." Since the total mass of each element on the filter must equal the sum of the elemental contribution from each source, a series of equations can be developed and solved simultaneously by a computer program. The department also performed analyses for organic and inorganic carbon since many of the local emission sources are combustion sources.

The emissions sources sampled in Libby are listed in Table 9. Some source samples were collected on filter media which allows direct elemental analysis. Bulk source samples were dried, sieved to less than 400 mesh (39 microns), and resuspended onto filter media. Department personnel gathered the source samples during January and February, 1984. The ambient sampling consisted of three high volume samplers located on the roof of the Lincoln County Courthouse and a dichotomous sampler with a 15 micron sampling head located one-half block away at the Wrecking Yard site. Each of the high volume samplers on the Courthouse utilized different filter media designed to obtain different types of data as specified in Table 10.

The department completed the collection of ambient and source samples during August, 1984. The department contracted with an environmental laboratory to perform the chemical analyses and the subsequent computerized CMB analysis. The department received the results of the CMB analysis during July of 1985.

TABLE 9

LIBBY SOURCE SAMPLES

Sample No.[a,b]	Sample	Collection Date
1	State Sandpile East of Libby	1/19/84
1A	State Sandpile East of Libby (split)	1/19/84
2	State Sand Shed East of Libby	1/19/84
2A	State Sand Shed East of Libby (split)	1/19/84
3	Champion Plt - Road Dust - Crossroad Near Office	2/28/84
3	Champion Plt - Road Dust - Crossroad Near Office (split)	2/28/84
4	County Sandpile Northwest of Libby	1/19/84
4A	County Sandpile Northwest of Libby (split)	1/19/84
5	City Sandpile Shed Near River	1/19/84
5A	City Sandpile Shed Near River (split)	1/19/84
6[c]	Champion Plt #9 Boiler Multiclone Catch	1/19/84
6A	Champion Plt #9 Boiler Multiclone Catch (split)	1/19/84
7	Champion Plt #8 Boiler Scrubber Catch	1/19/84
7A	Champion Plt #8 Boiler Scrubber Catch (split)	1/19/84
8[c]	Champion Plt #9 Boiler Scrubber Catch	1/19/84
8A	Champion Plt #9 Boiler Scrubber Catch (split)	1/19/84
9[d]	Snow Sample Collected Near Champion Plt	1/84
10	Road Dust, Mineral and West Fifth	2/28/84
10A	Road Dust, Mineral and West Fifth (split)	2/28/84
11[c]	Champion Plt, Road Dust, Logging Road from Libby Creek at Entrance to the Plant	2/28/84
11A	Champion Plt, Road Dust, Logging Road from Libby Creek at Entrance to the Plant (split)	2/28/84
12	Champion Plt #7 Boiler Multiclone Catch	1/19/84
12A	Champion Plt #7 Boiler Multiclone Catch (split)	1/19/84
13	Road Dust, Vacuum Sample, Main Ave. & Fifth	2/28/84
13A	Road Dust, Vacuum Sample, Main Ave. & Fifth (split)	2/28/84
14[c]	Road Dust, Fifth and Idaho	2/28/84
14A	Road Dust, Fifth and Idaho (split)	2/28/84
15	Road Dust, Main Avenue and Sixth	2/28/84
15A	Road Dust, Main Avenue and Sixth (split)	2/28/84
16[c]	Champion Plt, Sander Dust	1/19/84
16A	Champion Plt, Sander Dust (split)	1/19/84
17	Road Dust, California and Fifth	2/28/84
17A	Road Dust, California and Fifth (split)	2/28/84
18	Road Dust, Main Avenue and Fifth, on Main	2/28/84
18A	Road Dust, Main Avenue and Fifth, on Main (split)	2/28/84
19	Road Dust, Main and Fourth	2/28/84
19A	Road Dust, Main and Fourth (split)	2/28/84
20[c]	W.R. Grace Co. Bagging Plt, Baghouse Catch (in town)	2/28/84

Sample No.[a,b]	Sample	Collection Date
21	Libby, Champion Plt, South Veneer Dryer (Fiberglass Back), 65/72 min	2/28/84
22	Libby, Champion Plt, South Veneer Dryer (Fiberglass Back), 55/40 min	2/28/84

a All samples except 7, 7A, 8, 8A, 9, 21, and 22 were screened to pass a 400 mesh screen.
b All samples except #9 are being resuspended on dichotomous filters.
c These samples are also being resuspended on low volume filters.
d Not being processed at this time.

TABLE 10

FILTER MEDIA FOR LIBBY STUDY

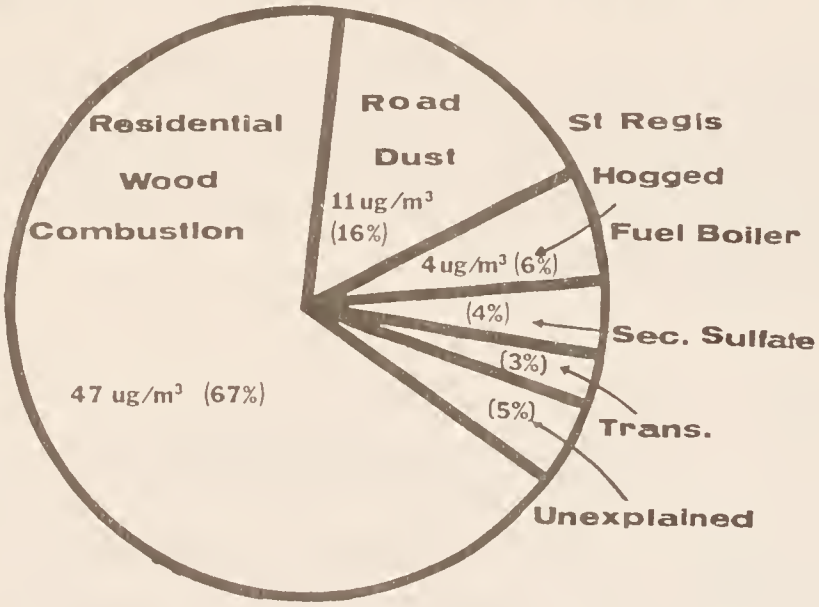
a.	Fiberglass	Determine TSP	Federal & Montana reference method for TSP.
b.	Teflon	Determine elemental concentrations	Low elemental background in filter media and smooth filter surface. Excellent for X-ray fluorescent analysis.
c.	Fired quartz	Determine organic and inorganic carbon	Low carbon background in filter media.

Figure 3 displays the results of the CMB analysis in the form of two pie charts. The first chart shows the major sources contributing to the fine fraction (0-2.5 microns) and the second shows the major contributors to the coarse fraction (2.5-15 microns). Emissions from residential wood combustion, re-entrained road dust, and the Champion hogged fuel boilers are the major contributors to the fine fraction while re-entrained road dust and the Champion hogged fuel boilers are the predominant sources impacting the coarse fraction.

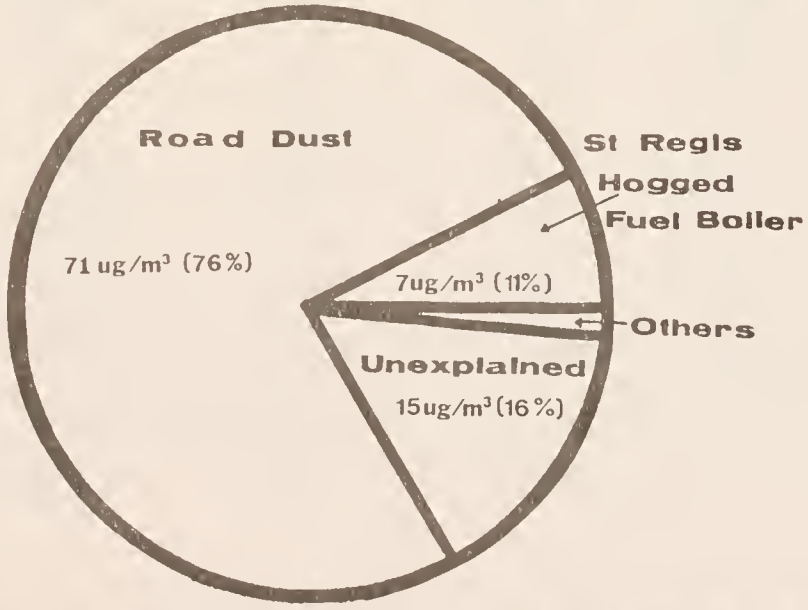
FIGURE 3

SOURCES CONTRIBUTING TO PARTICULATE LEVELS IN LIBBY'S ATMOSPHERE

LIBBY FINE PARTICULATE



LIBBY COARSE PARTICULATE



The department completed its analysis of the particle size distribution for the Libby airshed during July of 1985. Table 11 summarizes the results. The department operated the dichotomous sampler at the Wrecking Yard site from January 20, 1984, to March 31, 1984. Thirteen pairs of samples were collected. The average concentrations for the 2.5 micron, 2.5 to 15 micron, and 15 micron size groups were 67.6 ug/m^3, 86.5 ug/m^3, and 154.1 ug/m^3, respectively. The Environmental Protection Agency is proposing a new particulate standard for particles less than 10 microns in diameter. The standard will be set at an annual mean concentration in the range of 50-65 ug/m^3. It is obvious that Libby will not meet the proposed standard just as it does not meet the present TSP standards.

TABLE 11

PARTICLE SIZE DISTRIBUTION OF TSP
AT THE LIBBY WRECKING YARD SITE

		Concentration by Particle Size Group**			
Date	Back Scatter*	<2.5 micron	2.5-15 micron	<15 micron	Total Susp. Particulate
1/20/84	----	52.9	15.4	68.3	---
1/25/84	63.0	94.9	9.9	104.8	129
1/31/84	54.8	90.6	284.2	374.8	463
2/6/84	66/0	87.6	127.3	214.9	---
2/12/84	69.2	83.5	7.7	91.2	---
2/18/84	62.1	71.3	248.1	319.4	354
2/24/84	50.3	60.2	22.5	82.7	118
3/1/84	51.9	85.1	83.3	168.4	196
3/7/84	54.7	91.4	175.5	266.9	364
3/13/84	27.5	30.6	3.5	34.1	53
3/19/84	28.8	41.4	57.2	98.6	116
3/25/84	34.5	43.3	24.8	68.1	108
3/31/84	36.2	46.4	65.2	111.6	176
		$\bar{x}$ = 67.6	86.5	154.1	207.7
		$\bar{x}_T$ = 65.6	97.4	162.9	

SUMMARY

< 15u = 78.4% of TSP
< 2.5u = 31.5% of TSP
< 2.5u = 43.9% of RSP (15u)

---

* Twenty-four hour averages expressed in units of per meter
** All concentrations are in micrograms per cubic meter
$\bar{x}$ = the mean for all samples
$\bar{x}_T$ = the mean for all samples except samples for 1/20/84, 2/6/84 and 2/12/84

Since the proposed standard addresses only those particulates which penetrate deep into the human lung, it is very important that the department begin to design and implement the appropriate control strategies. The department also installed a collocated PM-10 monitor at the Lincoln County Courthouse in May, 1985.

7. The department performed linear regression analyses to compare each of the different particle size categories and the nephelometer data with each other (Table 12). The comparisons involved data collected between January 1, 1984, and March 31, 1984. The nephelometer measures the amount of light which is scattered backwards by fine particulates or visible gases. Figure 4 shows the relationship between particle size and the amount of light which is back-scattered. Particles with diameters between 0.1 and 1 micron account for over 95 percent of the back-scattered light. Therefore, it is not surprising that a very good correlation ($r = 0.888$) was observed between the less than 2.5 micron particulates and the associated twenty-four hour nephelometer readings. The correlations between the larger particle sizes and the nephelometer were poor at best.

TABLE 12

CORRELATION COEFFICIENTS BETWEEN BACK-SCATTER AND VARIOUS SIZE CLASSES OF PARTICULATES FROM LIBBY MONITORING SITES

	Back-scatter	<2.5 microns	2.5-15 microns	<15 microns	TSP
Back-Scatter	----	0.888 (12)	0.332 (12)	0.484 (12)	0.553 (14)
<2.5 microns	0.888 (12)	----	0.464 (13)	0.662 (13)	0.660 (10)
2.5-15 microns	0.332 (12)	0.464 (13)	----	0.982 (13)	0.971 (10)
<15 microns	0.484 (12)	0.662 (13)	0.982 (13)	----	0.987 (10)
TSP	0.553 (14)	0.660 (10)	0.971 (10)	0.987 (10)	----

NOTE: 1. TSP data was collected at the Lincoln County Courthouse while back-scatter and the particle size data was collected at the nearby Wrecking Yard site.

2. Parentheses denote the number of data pairs.

FIGURE 4

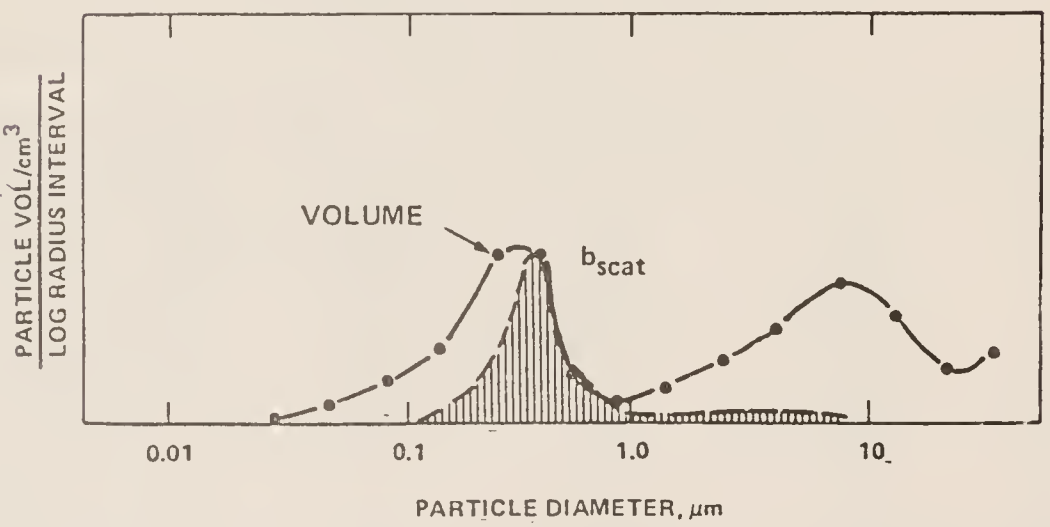


Figure 2-19 For a typical aerosol volume (mass) distribution, the calculated light scattering coefficient is contributed almost entirely by the size range 0.1 1.0 μm. The total b_{scat} and total aerosol volume are proportional to the area under the respective curves (Charlson et al., 1978).

The department also compared the various size classes of particulates with each other and obtained predictable results. The best correlation ($r = 0.987$) was observed between the <15 micron class and TSP. Since the <15 micron category made up 78.4% of the of the TSP during the study period, a good correlation was expected. The 2.5 to 15 micron class made up 46.9% of the TSP catch and correlated with TSP very well ($r = 0.971$). On the other hand, the <2.5 micron category comprised only 31.5% of the TSP and displayed only a fair correlation with TSP. The poorest correlation between size classes was between the <2.5 micron and the 2.5 to 15 micron category ($r = 0.464$). This relationship seems to indicate that the sources of fine particulate and coarse particulate in Libby are not the same. The results of the CMB study verified this hypothesis since it indicated that residential wood burning is the primary source of fine particulate and re-entrained road dust is the major contributor to the coarse fraction.

8. The remaining objectives of the Libby study were addressed in the 1985 Network Review under the sections addressing carbon monoxide and visibility.

9. The department intends to operate the Lincoln County Courthouse site indefinitely. The site will continue to quantify TSP levels in Libby and in the future it will track the effectiveness of any control strategies which are implemented. In addition, the department installed a collocated PM-10 sampler at the Courthouse in May, 1985. The department also intends to initiate a mutagen screening analysis on TSP filters from Libby. In light of the severe impact from residential wood combustion and the influence of emissions from the Champion

complex, and because both of these sources emit significant quantities of known and suspected mutagenic and carcinogenic compounds, the department believes mutagen testing will provide a good indication of some of the health effects associated with Libby's particulates.

Eureka

1. Eureka is a small town (pop. 1100) in northwestern Montana. The town is situated in some rolling hills along the Tobacco River approximately five miles upstream from Lake Koocanusa. A broad flat valley stretches to the north for ten miles to the Canadian Border.
2. In accordance with the 1984 Network Review, the department installed a TSP monitoring site at the Lincoln Electric Cooperative during May, 1984. The site is located approximately 150 feet south of U.S. Highway 93 at the point where it turns north to become Main Street. The city slopes gently to the south toward the monitoring site. Since the site is near the south edge of town, downslope winds during the night may carry particulate emissions from the entire town toward the site. The immediate area around the site is grassy. A large empty warehouse lies to the south and the Tobacco River is just beyond that.
3. Figure 5 shows the location of the Eureka site. The associated TSP data is summarized in Table 8.
4. The geometric mean for TSP for 1985 was 59 ug/m^3. The highest individual readings were 190 ug/m^3 and 159 ug/m^3. These twenty-four hour concentrations exceeded the federal secondary ambient standards although they were much lower than data from 1984. Figure 6 is a bar graph of the 1985 TSP data.

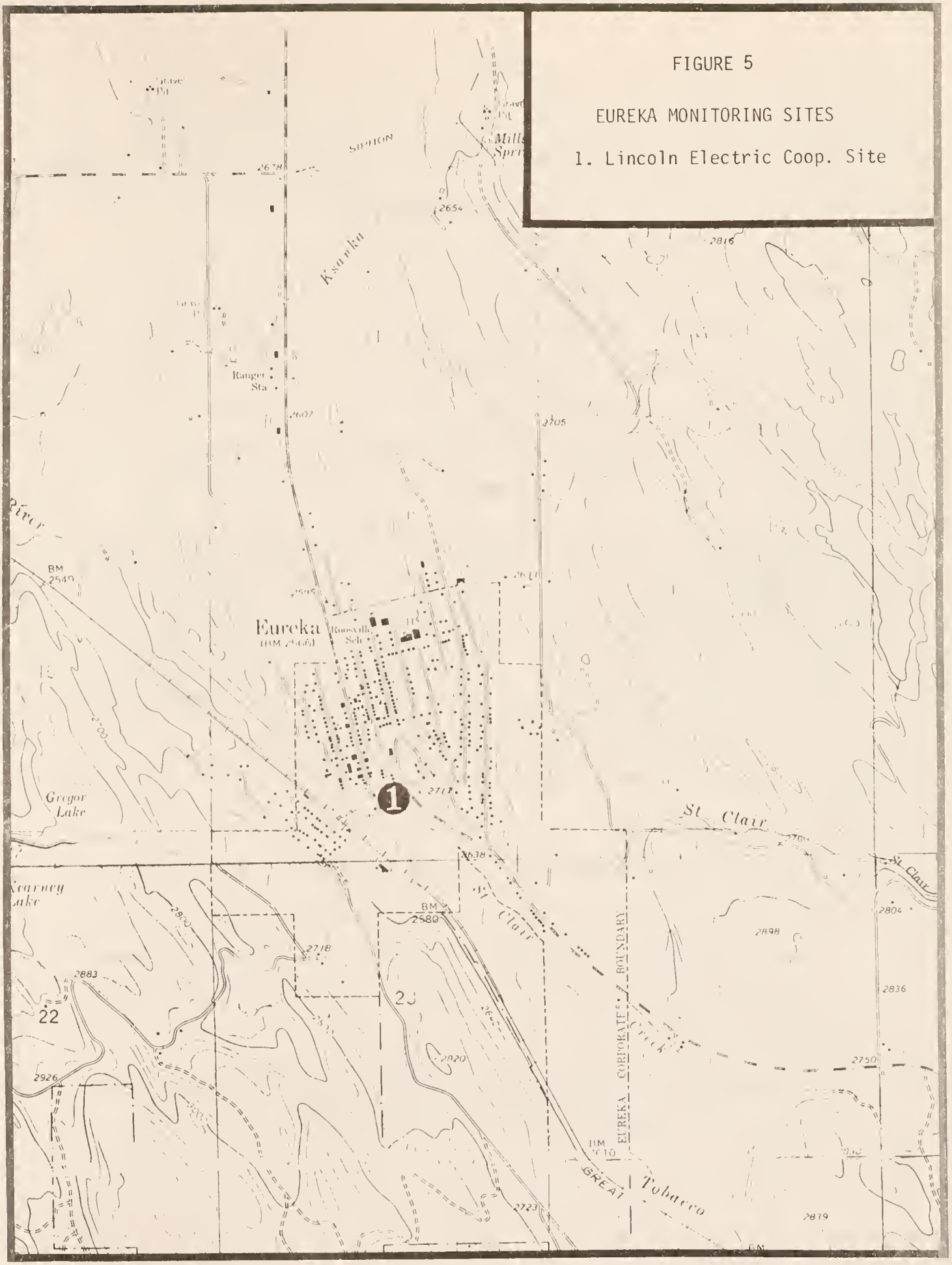
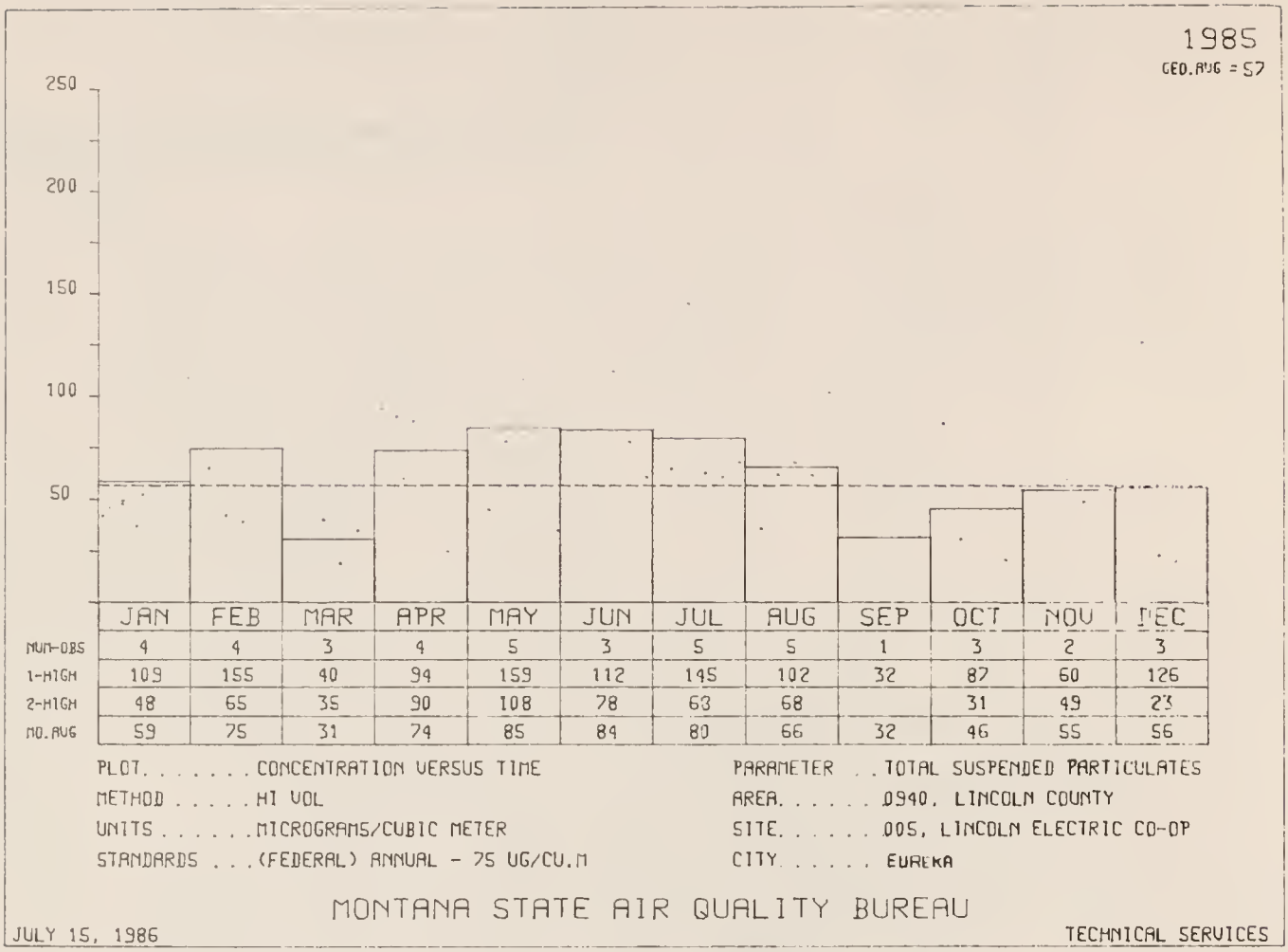


FIGURE 5

EUREKA MONITORING SITES

1. Lincoln Electric Coop. Site

FIGURE 6


1985
GEO.AVG = 57
250
200
150
100
50
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
NUM-OBS 4 4 3 4 5 3 5 5 1 3 2 3
1-HIGH 109 155 40 94 159 112 145 102 32 87 60 126
2-HIGH 48 65 35 90 108 78 63 68 31 49 23
NO.AVG 59 75 31 74 85 84 80 66 32 46 55 56
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0940, LINCOLN COUNTY
SITE. . . . . 005, LINCOLN ELECTRIC CO-OP
CITY. . . . . EUREKA
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

5. Since TSP concentrations are hovering around the ambient standards, the department intends to install a second high volume sampler to facilitate every third day sampling. In addition, the department plans to install a PM-10 monitor at the Eureka site during the fall of 1986.

Thompson Falls

1. Thompson Falls is a small town of 1500 people situated on the north side of the Thompson Falls Reservoir. The reservoir is a small

impoundment on the Clark Fork River. The Clark Fork River valley near Thompson Falls runs east and west, with mountains rising to 7000 feet on the north and south. As with all western Montana valleys, Thompson Falls experiences severe temperature inversions during the fall and winter.

2. Figure 7 is a map of Thompson Falls showing the location of the sampler while Figure 8 is a graphical plot of the last three years of TSP data. Table 8 also lists the associated TSP data.

3. The Thompson Falls sampler is located on the roof of the Sanders County Courthouse. During 1985, the Courthouse site recorded a geometric mean for TSP of 81 ug/m^3. This concentration is above the Montana and federal primary standards of 75 ug/m^3 and was the second highest geometric mean recorded in Montana. The 1985 mean was exactly the same as the 1984 mean. The highest twenty-four hour concentrations were 604 ug/m^3 and 362 ug/m^3. These values are also well above the state and federal primary standards and the 604 ug/m^3 concentration was the second highest twenty-four hour value recorded in Montana during 1985.

4. The Thompson Falls area obviously has an air quality problem. The most likely causes are residential wood burning, re-entrained road dust, and emissions from a nearby sawmill. The department has completed a source apportionment study in Libby, is initiating one for Kalispell, and is considering one for Bozeman. Depending on the results of these studies, the department may initiate similar studies in Butte and Thompson Falls. Even without a community-specific study in Thompson Falls, the results in the other areas may demonstrate a need for a regionwide control strategy. If Thompson Falls is similar to other

FIGURE 7

THOMPSON FALLS MONITORING SITES

1. Sanders County Courthouse site

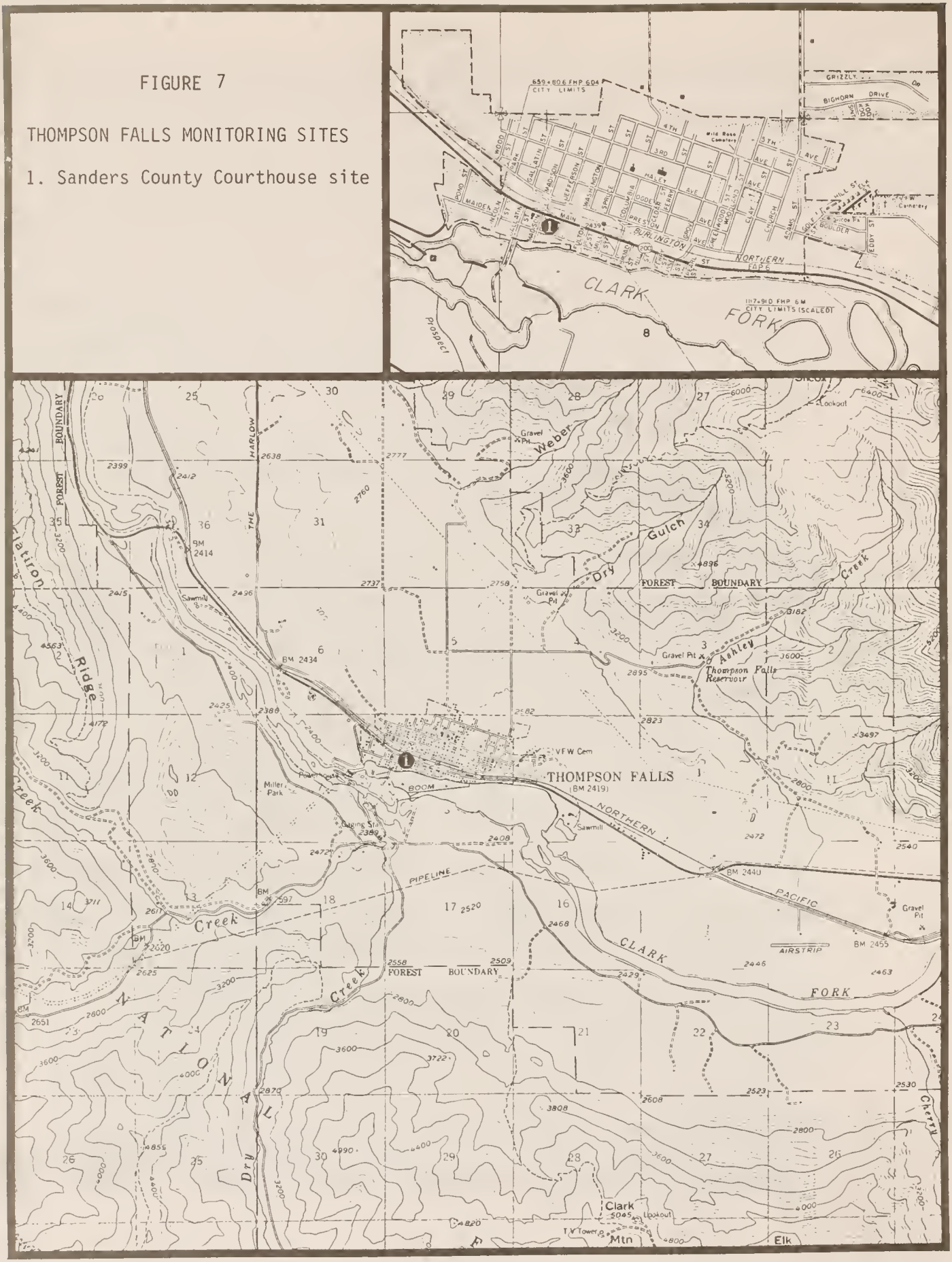
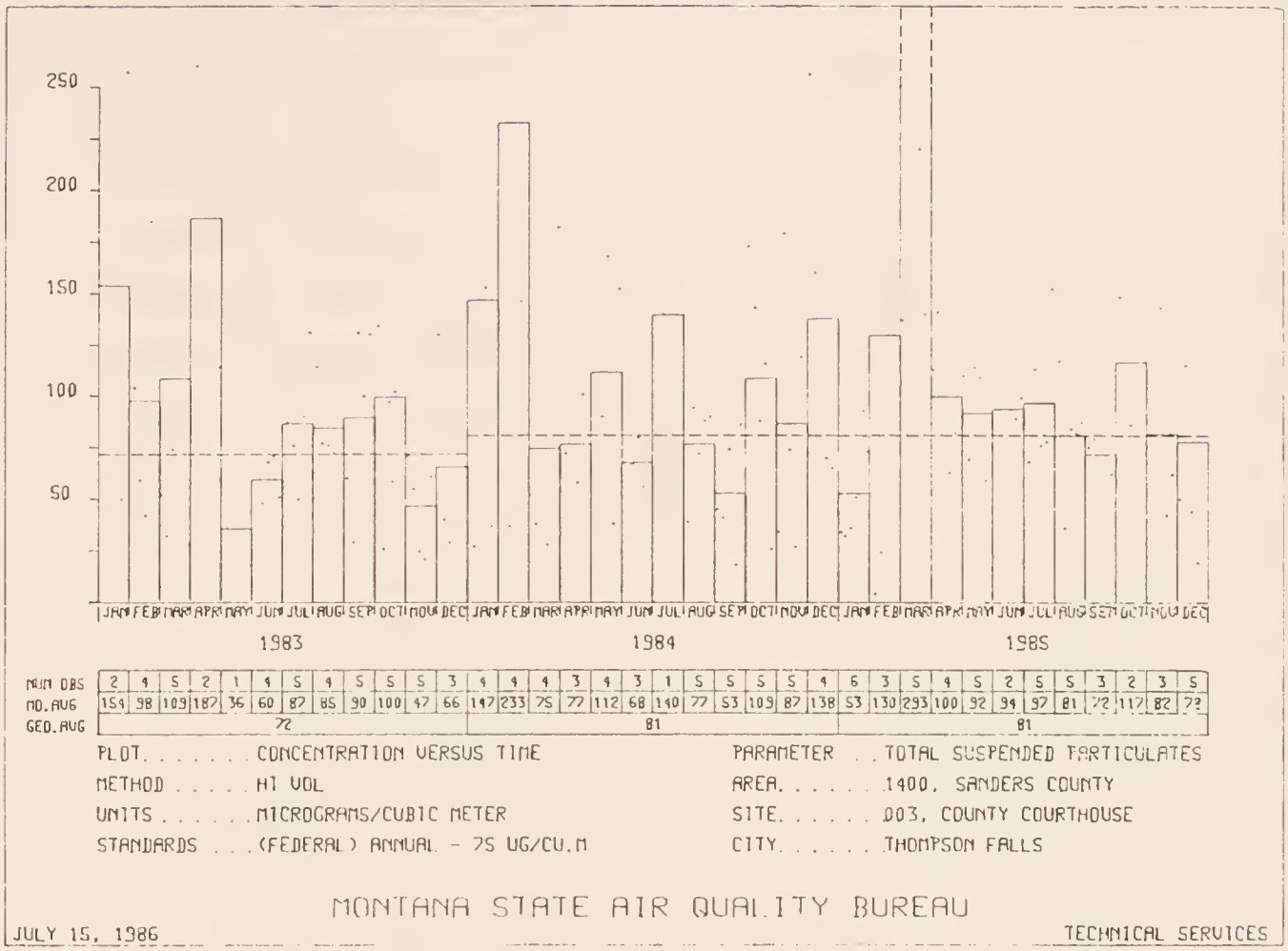


FIGURE 8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JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1983
1984
1985
NUM OBS 2 4 5 2 1 4 5 4 5 5 5 3 4 4 4 3 4 3 1 5 5 5 5 4 6 3 5 4 5 2 5 5 3 2 3 5
MO.AVG 154 98 109 187 36 60 87 85 90 100 67 66 147 233 75 77 112 68 140 77 53 109 87 138 53 130 293 100 92 94 97 81 72 117 82 73
GEO.AVG 72 81 81
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 1400, SANDERS COUNTY
SITE. . . . . 003, COUNTY COURTHOUSE
CITY. . . . . THOMPSON FALLS
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

western Montana communities and regionwide controls are enacted, Thompson Falls may share the benefits.

5. The department will continue to monitor for TSP in Thompson Falls. In addition, the department installed a PM-10 monitor at the Courthouse site during May, 1985.

Kalispell

1. Kalispell is the commercial center of the Flathead Valley. The city has a population of approximately 10,000 people with perhaps an additional 10,000 people living within three miles of the city limits. The Flathead Valley is predominantly agricultural; however, subdivisions have made inroads into the agricultural land base over the past ten years. The mountains, lakes and streams in the area also attract a large number of tourists. The Big Mountain ski resort twenty miles north of Kalispell makes the area a year-round vacation destination. The high mountains to the east tend to block the prevailing west winds, resulting in decreasing precipitation moving toward the west and very light valley winds. Temperature inversions are prevalent during the fall and winter months.
2. Figure 9 locates the Kalispell monitoring sites and Table 8 summarizes the associated data.
3. The Universal Athletics site is located in the downtown area of Kalispell and has operated for six years. Figure 10 displays the last three years of TSP data from the Universal Athletics site in a graphic form. In 1985, the geometric mean for TSP increased 13 percent to 79 ug/m^3. The highest twenty-four hour concentration was 370 ug/m^3. This concentration was substantially higher than the highest concentration in 1984. In 1985, the data from this site exceeded all ambient standards except for the federal primary twenty-four hour standard.
4. The department plans to continue routine TSP sampling at the Universal Athletics site indefinitely. The department also intends to initiate routine mutagen screening of TSP filters and to increase the frequency

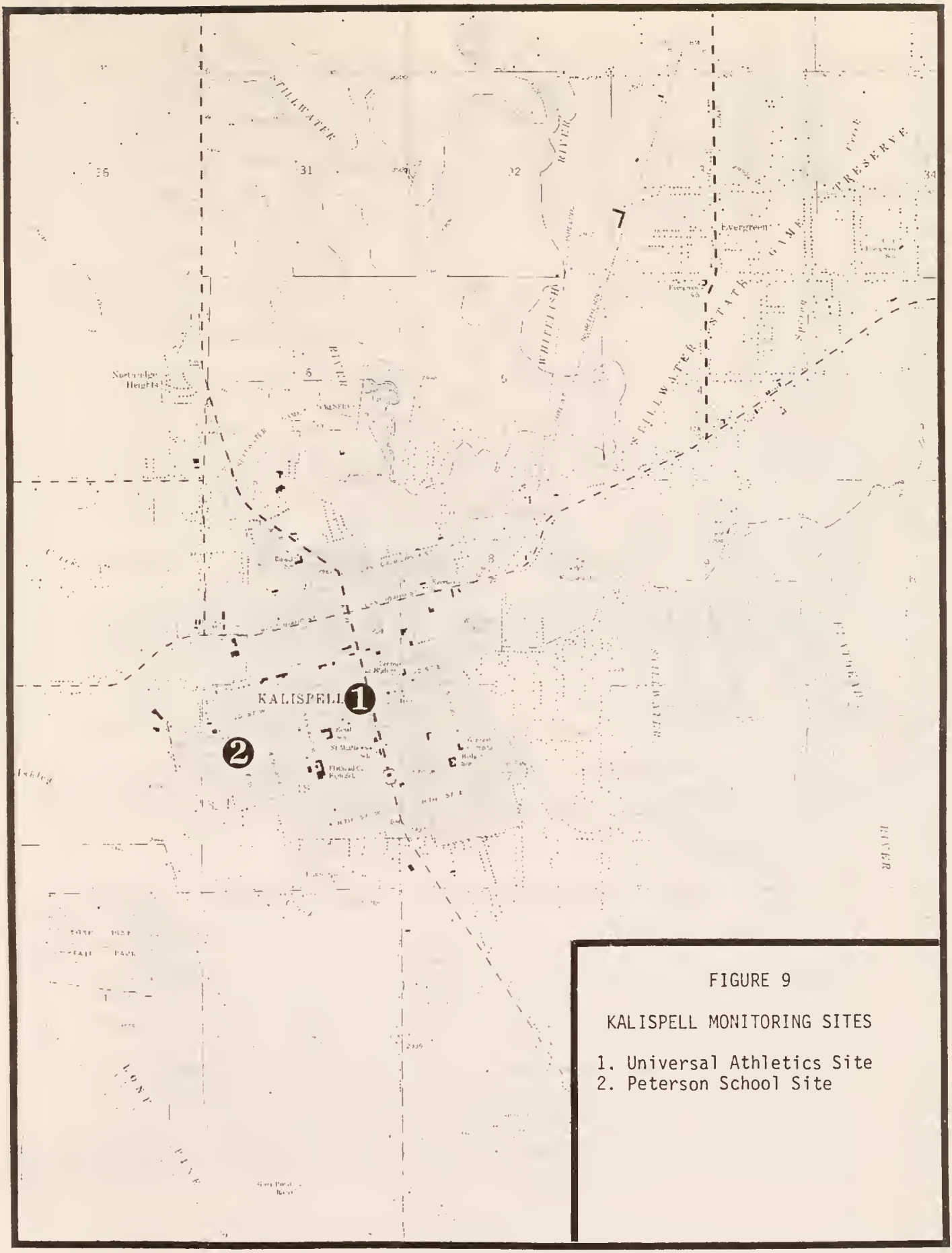
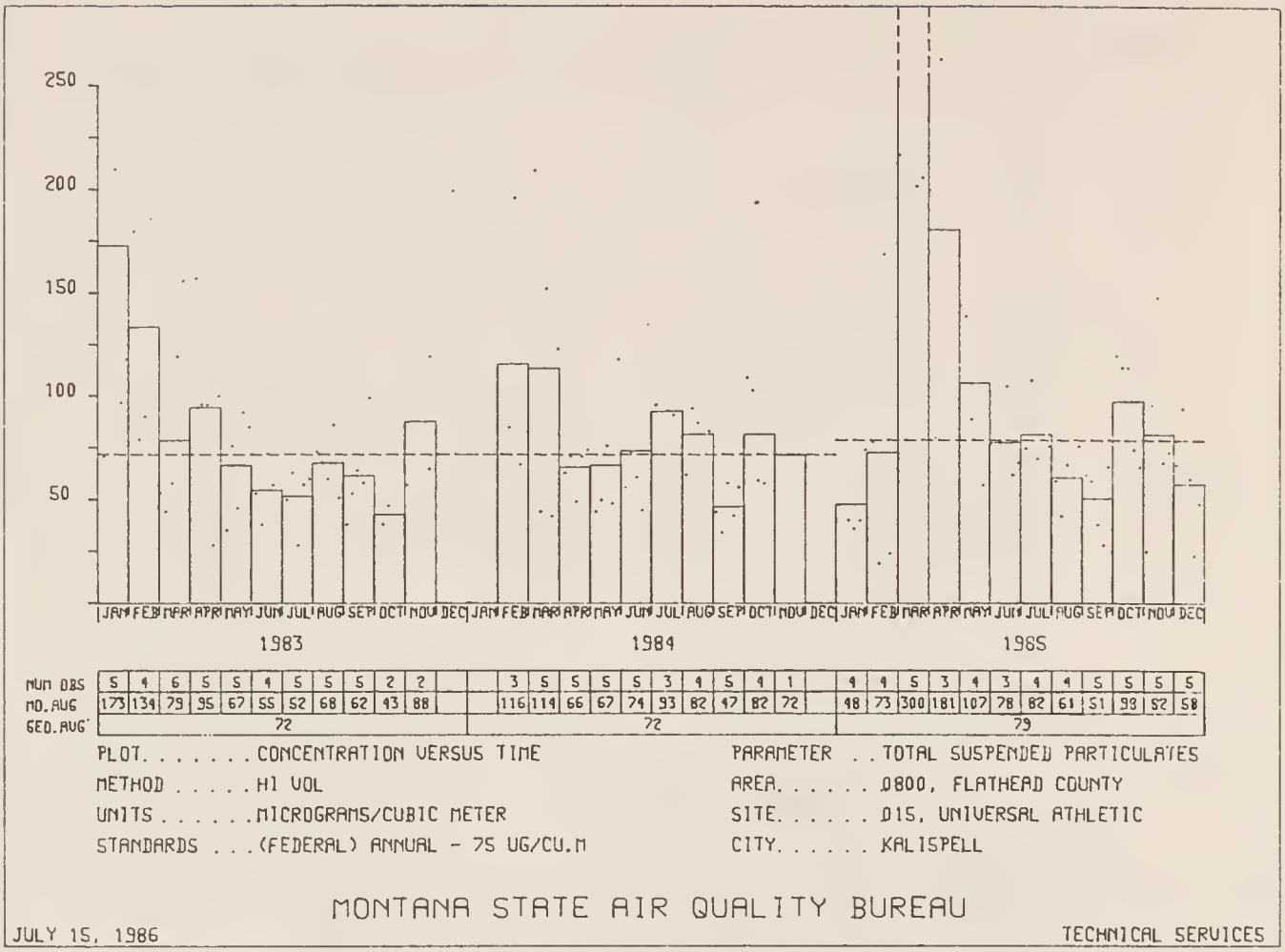


FIGURE 9

KALISPELL MONITORING SITES

1. Universal Athletics Site
2. Peterson School Site

FIGURE 10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1984
1985
NUM OBS 5 4 6 5 5 4 5 5 5 2 2 3 5 5 5 5 3 4 5 4 1 4 4 5 3 4 3 4 4 5 5 5 5
MO. AVG 173 134 79 95 67 55 52 68 62 43 88 116 114 66 67 74 93 82 47 82 72 98 73 300 181 107 78 82 61 51 98 52 58
GED. AVG 72 72 79
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0800, FLATHEAD COUNTY
SITE. . . . . 015, UNIVERSAL ATHLETIC
CITY. . . . . KALISPELL
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

of TSP monitoring to every third day once the CMB study is completed in late 1987. PM-10 monitoring was initiated during May, 1985. As mentioned above, the department intends to conduct a detailed source apportionment study in Kalispell during late 1986 and most of 1987. The study will require an additional high volume sampler and three dichotomous samplers to be located at the Universal Athletics site. These samplers will be necessary because the sampling will utilize

Teflon, quartz and fiberglass filter media. The study will include source sampling to establish chemical "fingerprints" of the various sources and utilize the chemical mass balance technique. A draft protocol of the study is available at the department's Helena office.

5. In conjunction with the Kalispell source apportionment study, the department intends to operate two primary monitoring sites. As mentioned earlier, the Universal Athletics site will be the first, while the second location will be at the Petersen School in the western part of Kalispell. The department chose this location after an acceptable site farther south could not be found. Although the site is still in a residential area, the department would have preferred a site nearer the center of the west side residential area. The site will be equipped with a high volume sampler and three dichotomous samplers similar to the Universal Athletics site.

Columbia Falls

1. Columbia Falls is an industrial town of 3100 people located in the extreme northeast corner of the Flathead Valley. In the vicinity of Columbia Falls are a plywood-particleboard-sawmill complex, an additional sawmill, and an aluminum reduction plant.

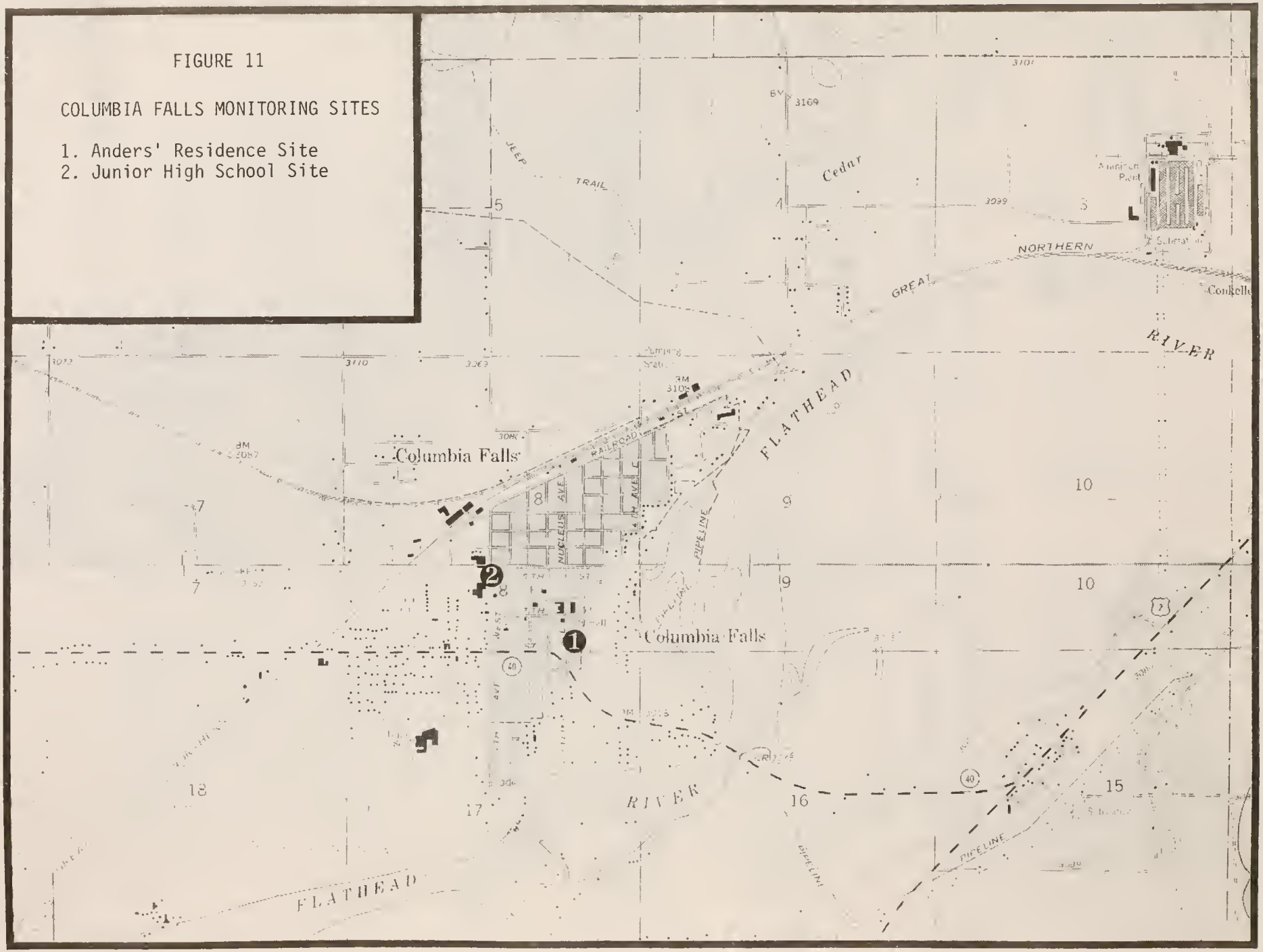
   Wind patterns in the area are dominated by drainage winds through Badrock Canyon and through a gap north of town which drains the north fork of the Flathead River.

2. Figure 11 is a map locating the Columbia Falls monitoring sites. Table 8 summarizes the associated TSP data.

FIGURE 11

COLUMBIA FALLS MONITORING SITES

1. Anders' Residence Site
2. Junior High School Site



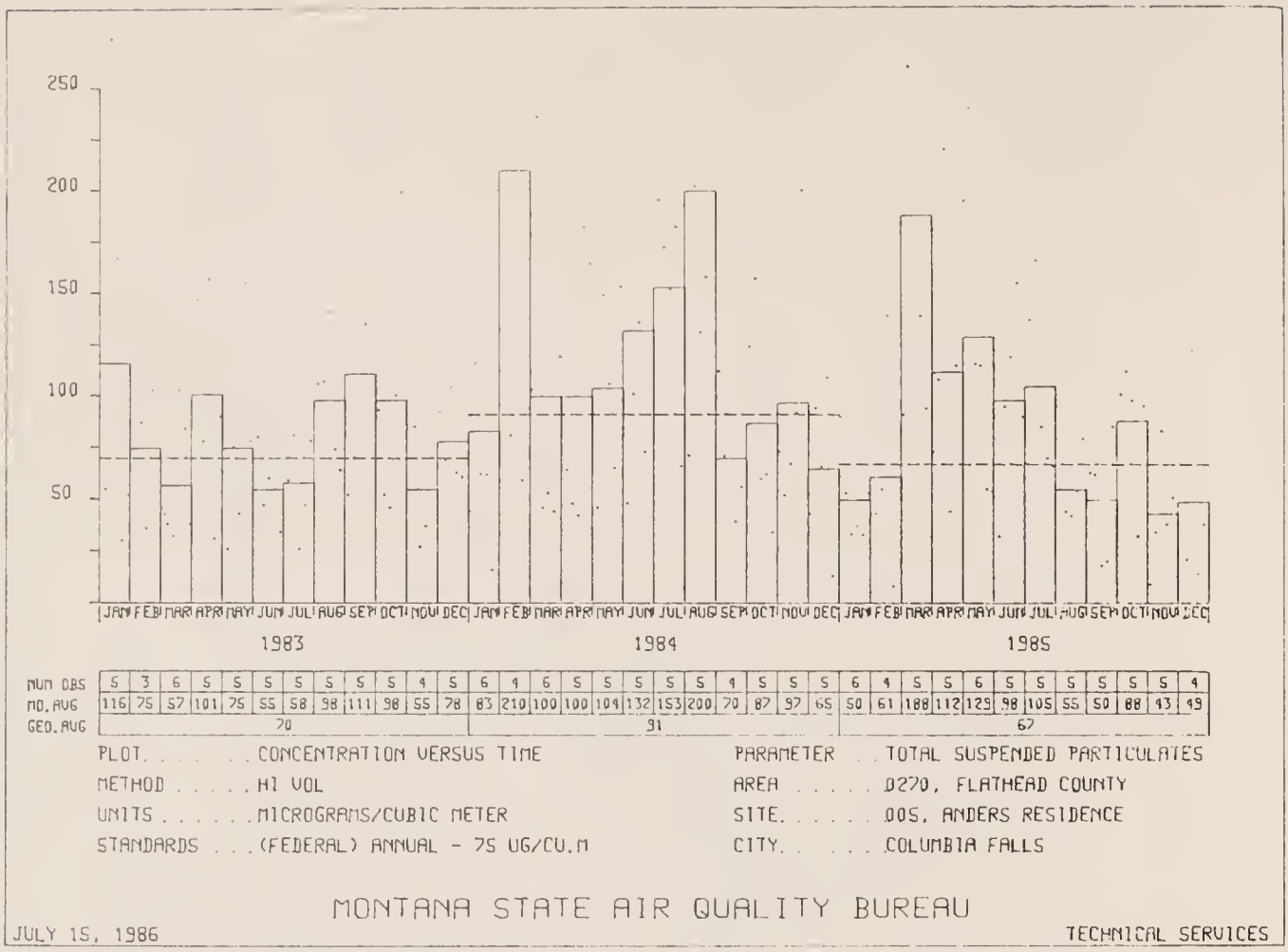
3. The Anders Residence high volume sampler is located on the roof of a garage one block east of Nucleus Avenue. The sampler intake is approximately at the same height as the road surface. This area of Columbia Falls is primarily residential although it is adjacent to the central business district and strip development along Highway 40.

4. The Anders Residence site was responsible for the nonattainment designation of Columbia Falls. A subsequent microinventory conducted in 1979 identified fugitive dust from paved and unpaved streets as accounting for over 90 percent of the TSP. A paving project involving Nucleus Avenue, the main street of Columbia Falls, was completed in 1981. Highway 40 through Columbia Falls was also paved, curbed and guttered during the summer of 1984.

5. Figure 12 graphically displays the TSP data from the Anders site for the last three years. The 1985 geometric mean for TSP at the Anders site was 67 ug/m^3. This constituted a substantial improvement over the 91 ug/m^3 recorded during 1984. The first and second highest individual readings were 355 ug/m^3 and 260 ug/m^3. Although 1985 TSP concentrations at the Anders site complied with the state and federal primary standards for annual average, the federal secondary standard for annual average was exceeded. In addition, all state and federal twenty-four hour standards were violated.

6. Table 13 describes the total suspended particulate data by season and month of the year. Table 13 further describes the TSP data in relation to the two major construction projects. The highest concentrations occurred in the snow-free months of 1978 through 1981, and in 1984. The years of 1978 through 1980 were prior to the reconstruction of

FIGURE 12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1983
1984
1985
NUM OBS 5 3 6 5 5 5 5 5 5 5 4 5 6 4 6 5 5 5 5 5 4 5 5 5 6 4 5 5 6 5 5 5 5 5 5 4
MO.AVG 116 75 57 101 75 55 58 98 111 98 55 78 83 210 100 100 104 132 153 200 70 87 97 65 50 61 188 112 129 98 105 55 50 88 43 49
GEO.AVG 70 91 67
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA . . . . . 0270, FLATHEAD COUNTY
SITE. . . . . 005, ANDERS RESIDENCE
CITY. . . . . COLUMBIA FALLS
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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TABLE 13

TSP BY SEASON AND YEAR FROM THE
COLUMBIA FALLS ANDERS RESIDENCE SITE

Year	Total Suspended Particulates (ug/m^3) Jan.,Feb.,Nov.,Dec.	March - Oct.
1978-1980 (Preconstruction)	79 (59)	164 (119)
1981 (Construction year)	106 (20)	168 (41)
1982-1983 (Nucleus Avenue complete)	69 (38)	89 (81)
1984 (Construction year)	107 (20)	181 (40)
1985 (Post-construction)	50 (19)	104 (41)

NOTE: Parentheses denote the number of samples.

Nucleus Avenue and, according to the nonattainment analysis, re-entrained road dust was the primary emission source affecting the site. In 1981, Nucleus Avenue was reconstructed and TSP concentrations increased, probably due to fugitive dust from the construction activity.

During 1982 and 1983, the concentrations were down considerably, presumably due to the effects of the new street. With the beginning of construction on Highway 40, the 1984 readings increased. The 1985 data again decreased indicating that the completion of both projects is having an impact on TSP levels. The department is convinced that emissions of re-entrained road dust have been drastically reduced but that further reductions may be necessary. Emissions from residential wood combustion and the wood products industry may also be precluding compliance with ambient standards.

7. The department intends to shut down the Anders Residence site on December 31, 1986. Although the site meets all the "must" siting criteria, it is not a good site. It lies in a small depression below the surface of Nucleus Avenue and has several wood stove chimneys nearby. If the site was not essential for tracking the effectiveness of the control strategies, the department would have moved it years ago. During May, 1985, the department established a PM-10 monitoring site at the Junior High School in the northwestern part of town. In October, 1985, the department added a TSP monitor to the site.

8. The department performed a linear regression analysis on the TSP data from the Anders Residence and the Junior High School sites. Since the Junior High site became operational in October, only twelve matched

pairs of data were available. The results of the analysis established that the means at both sites were identical (55.3 ug/m^3) and that the correlation coefficient was excellent with r = 0.933. The department believes that the Junior High School site adequately describes particulate concentrations throughout Columbia Falls and that the Anders site should eventually be eliminated. However, due to the limited data available at this time, the department will not disassemble the Anders site until December 31, 1986. The delay will allow the department to compare the 1986 data between sites. In addition, the department intends to install two more samplers at the Junior High School site during October, 1986. One sampler will be used as a collocated sampler while the other will allow for the start of an every third day sampling schedule.

Prospective Sites

1. The department will add Whitefish, Troy and Superior to its list of prospective sites. The department assigned a moderate priority to establishing a site in Whitefish, but Troy and Superior received relatively low ratings. Of course, funding will be the deciding factor as to whether the sites actually become a reality.
2. The department previously monitored TSP in Whitefish at a city park near the eastern edge of the city. The geometric mean for 1982 was 49 ug/m^3 and for the first half of 1983 it was 62 ug/m^3. The department shut the site down in July, 1983, because concentrations were relatively low compared to other western Montana communities and because of a reduction in funds associated with the completion of the Flathead Project. The department now believes that our

decision to eliminate the site may have been a little too hasty. In addition, Whitefish has continued to expand as a year-round tourist destination and TSP levels may be increasing. If a site is established, the department intends to locate it just east of the central business district at the edge of the residential area (see Figure 13). The department believes a site at this location will measure the highest concentrations present in Whitefish.

3. If the department establishes TSP sites in Troy or Superior, the preferred locations will be at the transition point between the central business district and residential areas (Figures 14 and 15). Such locations will be impacted by emissions from both residential wood combustion and re-entrained road dust.

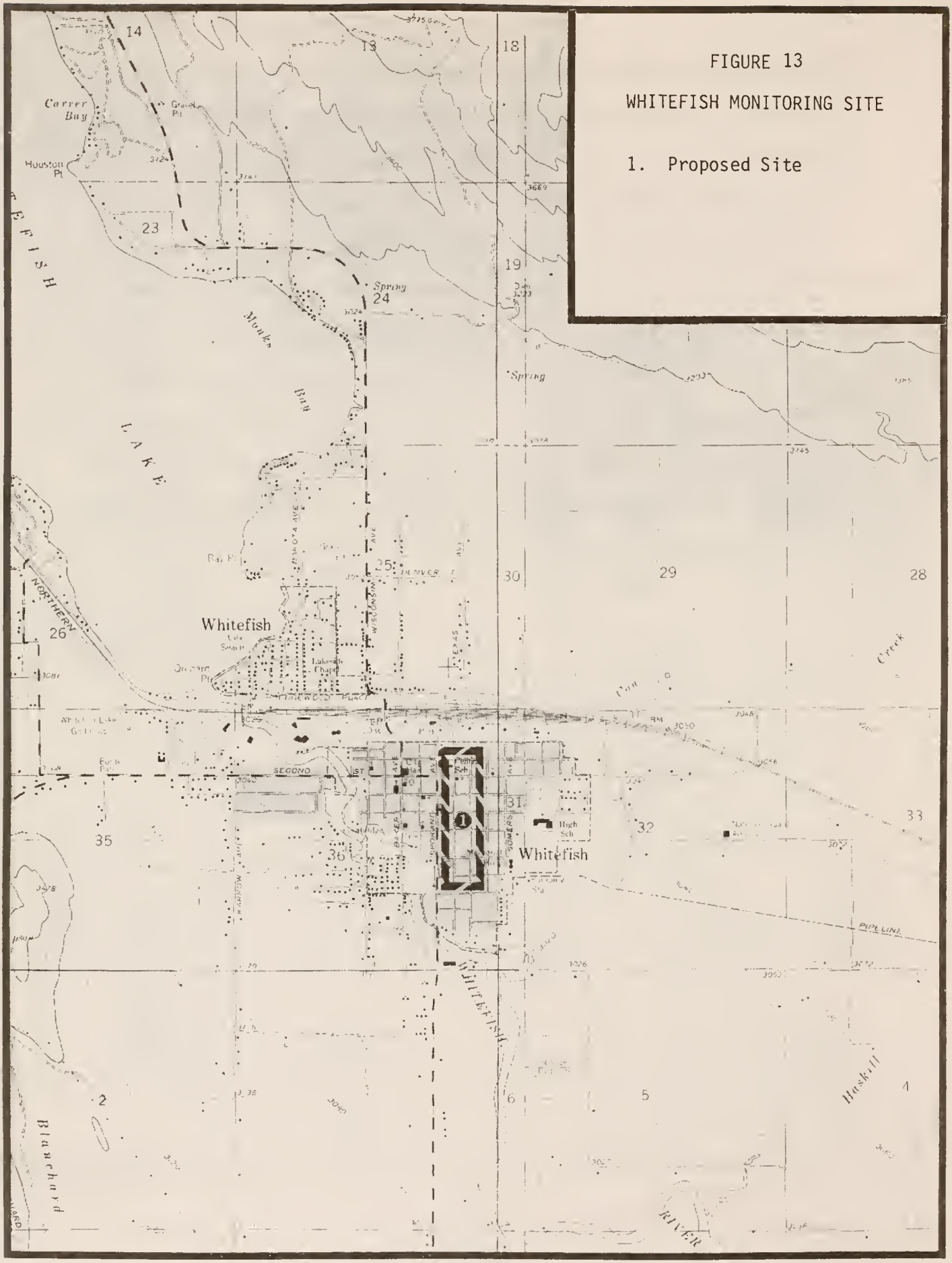


FIGURE 13

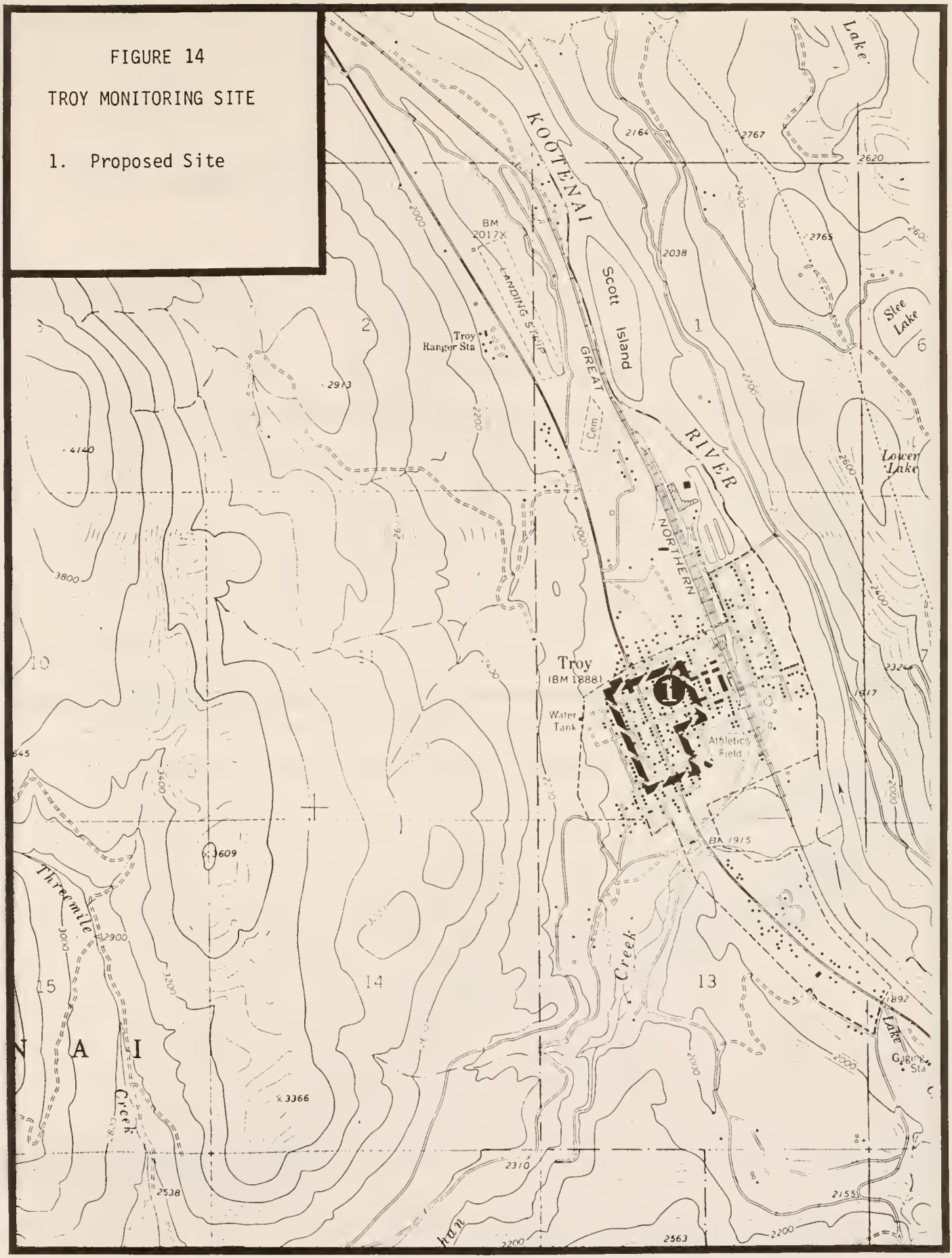
WHITEFISH MONITORING SITE

1. Proposed Site

FIGURE 14

TROY MONITORING SITE

1. Proposed Site



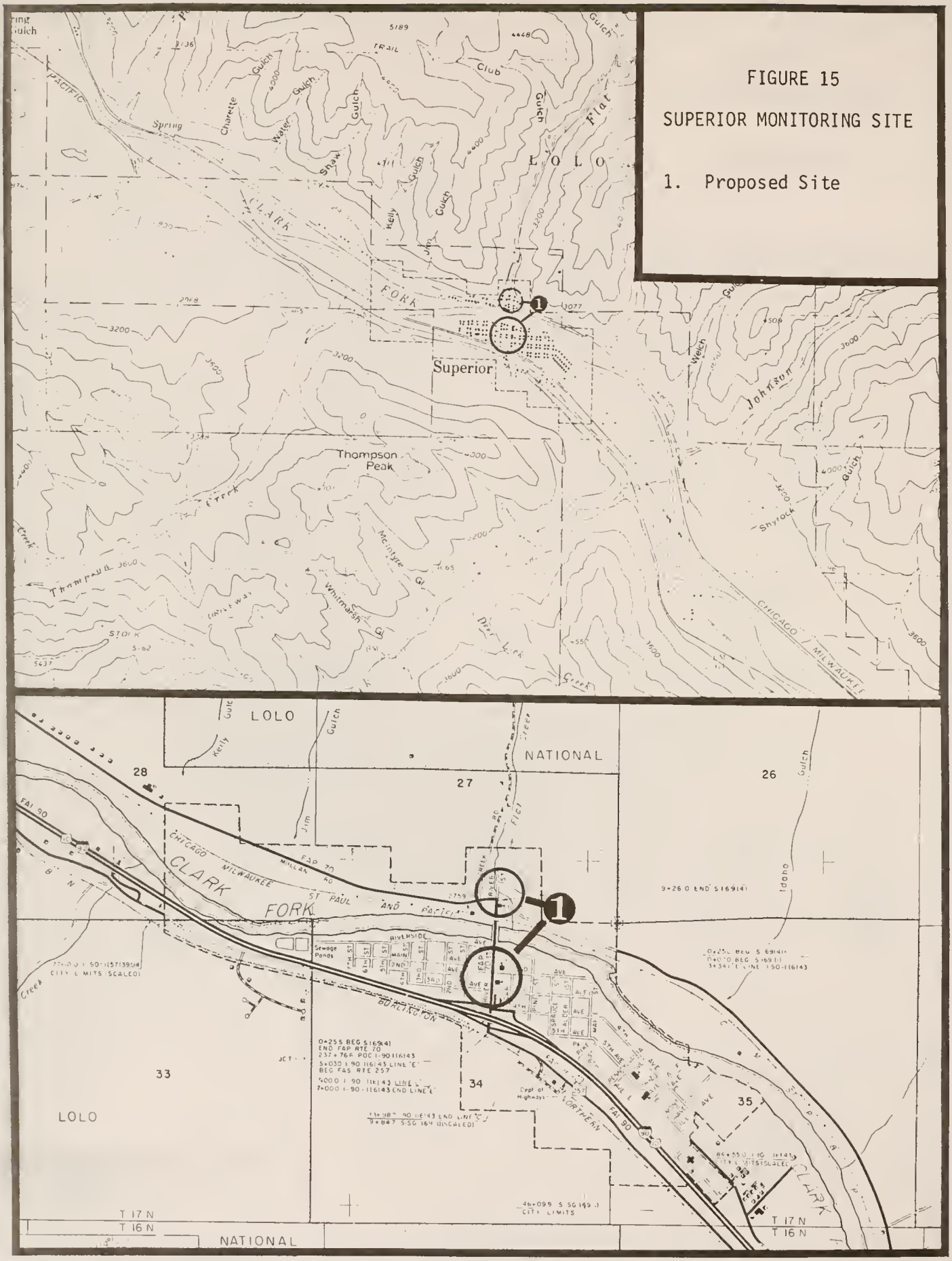


FIGURE 15
SUPERIOR MONITORING SITE
1. Proposed Site
Superior
Thompson Peak
LOLO
NATIONAL
CLARK FORK
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
BURLINGTON NORTHERN
FAI 90
T 17 N
T 16 N

WEST CENTRAL

MONTANA

West central Montana includes Missoula, Granite, Powell and Ravalli Counties. The city of Missoula is the commercial hub of the area. This region is characterized by forested mountains and narrow valleys. The region experiences poor dispersion conditions during the fall and winter months.

Missoula

1. The city of Missoula lies within a deep mountain valley just above the confluence of the Clark Fork and Bitterroot Rivers. Over the past 15 years Missoula has experienced residential and commercial growth primarily to the southwest onto the south hill and toward the small community of Lolo. In addition, many nearby timbered canyons have experienced subdivision growth. Due to the residential growth and higher utility rates, the use of firewood for heat and enjoyment has also expanded. Winds in the Missoula Valley are light, averaging 6.1 mph. Prevailing winds are from the west or northwest. During the fall and winter, Missoula is affected by severe temperature inversions. These inversions are very persistent, lasting for days or weeks at a

time. During temperature inversions, very high concentrations of total suspended particulates have been recorded.

2. The locations of the Missoula monitoring sites are shown on Figure 16. Table 8 summarizes the TSP levels for the Missoula sites.

3. During 1985, the Missoula County Health Department operated five total suspended particulate monitoring sites and one PM-15 site within the metropolitan area of Missoula. They also performed calibrations and filter analysis for two particulate sites operated by Stone Container, Inc., near their Kraft pulp mill at Frenchtown.

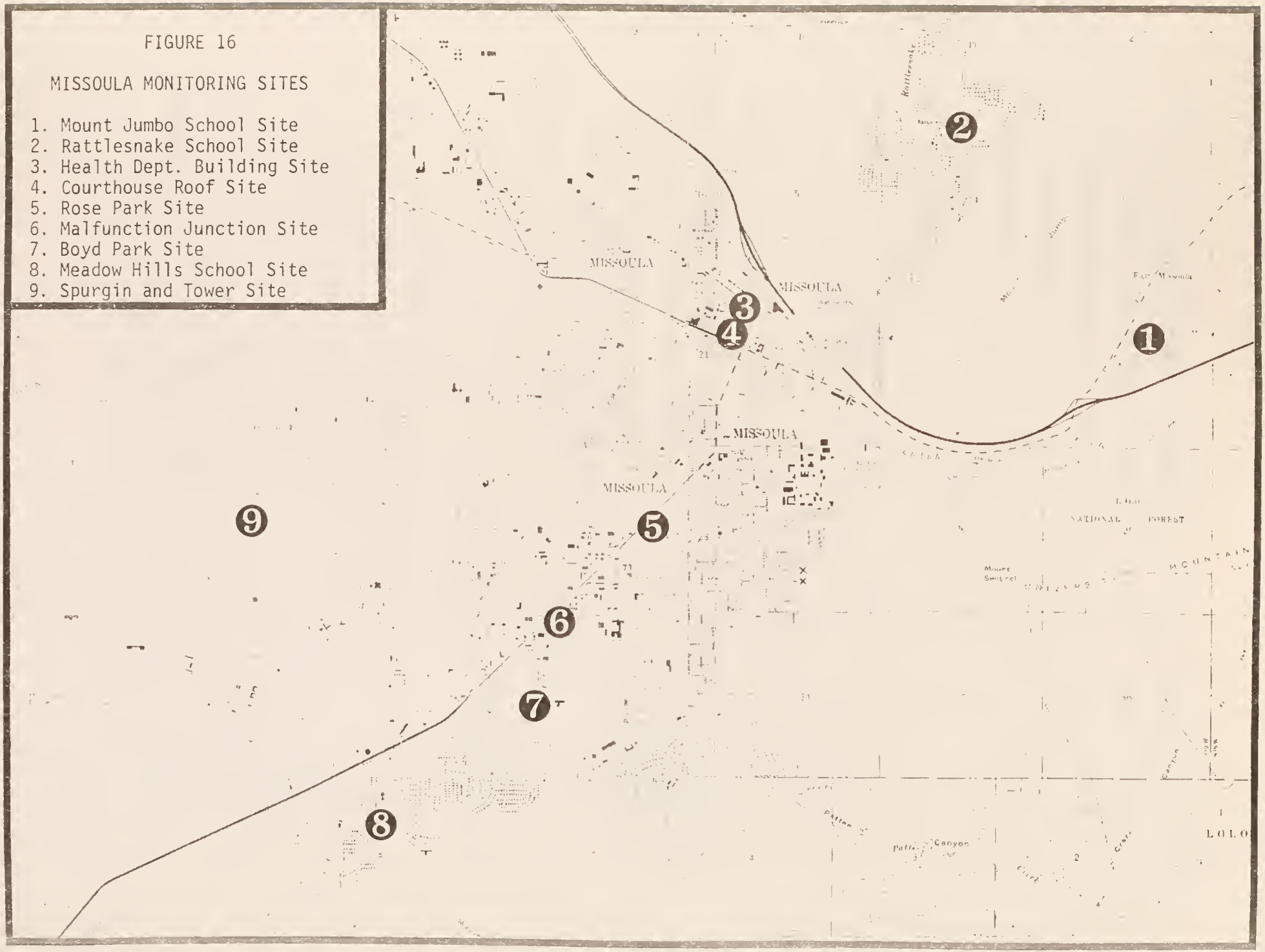
4. The Missoula County Health Department operates the Rose Park monitoring site as the primary particulate monitoring site in Missoula. The site is equipped with two high volume samplers, two PM-10 samplers and a GCA Beta gauge (APM) to continuously measure particulates in two size categories. With this equipment, Missoula County gathered daily TSP and PM-10 data and continuous data for particules less than 2.5 microns and 2.5-15 microns. The county uses the continuous data from the GCA Beta gauge for emergency episodes purposes. During 1985, they also tested a continuous Dasibi 10 micron particulate monitor at this location. The Dasibi monitor was found to have a major design problem and Missoula County is attempting to purchase a more suitable sampler. The county intends to eventually use the new sampler for emergency episode forecasting and thereby allow them to move the GCA Beta gauge to Boyd Park.

5. Rose Park is located in a residential area near the geographical center of Missoula. However, a major arterial, Brooks Avenue, lies within one block of the sampler. Several large trees near the site have grown to

FIGURE 16

MISSOULA MONITORING SITES

1. Mount Jumbo School Site
2. Rattlesnake School Site
3. Health Dept. Building Site
4. Courthouse Roof Site
5. Rose Park Site
6. Malfunction Junction Site
7. Boyd Park Site
8. Meadow Hills School Site
9. Spurgin and Tower Site



the point where the dripline is exactly 20 meters from the nearest high volume sampler. With this in mind, Missoula County personnel are considering eventually making Boyd Park the primary monitoring site in Missoula and transferring some of the monitoring from Rose Park.

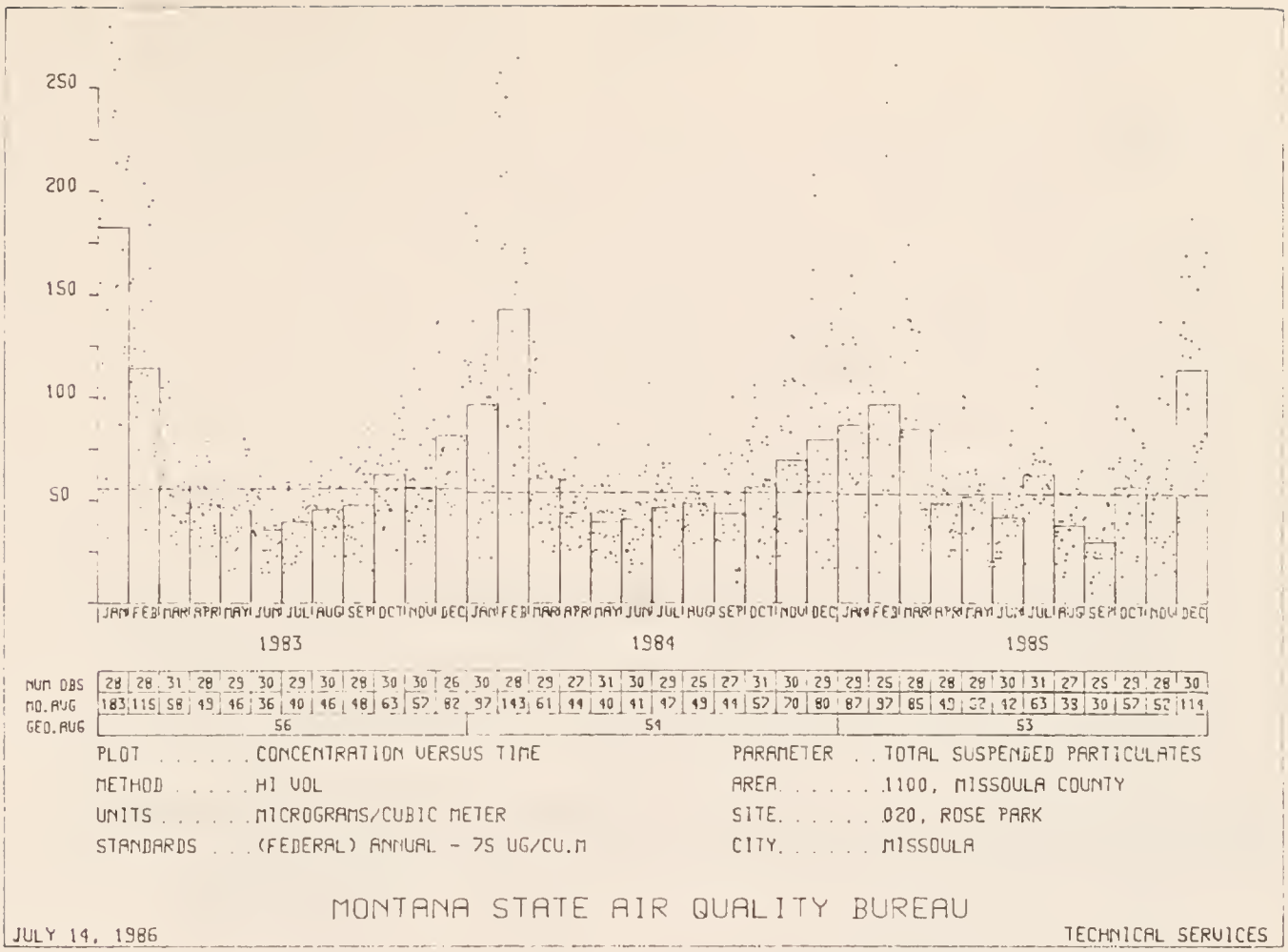
6. In 1985, the geometric mean for total suspended particulates was 53 ug/m^3. The first and second highest twenty-four hour concentrations were 340 ug/m^3 and 261 ug/m^3. The data shows compliance with the annual standards but the state and federal twenty-four hour standards were exceeded. Figure 17 is a three-year plot of monthly TSP concentrations at the Rose Park site.

7. The Missoula County Health Department intends to operate the Rose Park site in its present configuration at least two more years. During the interim period, they plan to statistically compare the TSP data from Rose Park and Boyd Park. If the means are roughly equal and if the individual concentrations track each other, they plan to shift the focus for episode monitoring from Rose Park to Boyd Park. If such action is taken, Missoula County will probably reduce the amount of monitoring performed at Rose Park.

8. The Boyd Park monitoring site is located in a residential area on the south side of the city just below the South Hill. Homeowners in this part of Missoula use a large amount of wood for home heating. The actual site is located in a grassy area well off the street. The site easily meets all siting criteria.

9. During 1985, the Missoula County Health Department operated two high volume samplers and two PM-10 size selective inlet (SSI) at Boyd Park. With this equipment, the county gathered daily TSP and PM-10 data. The

FIGURE 17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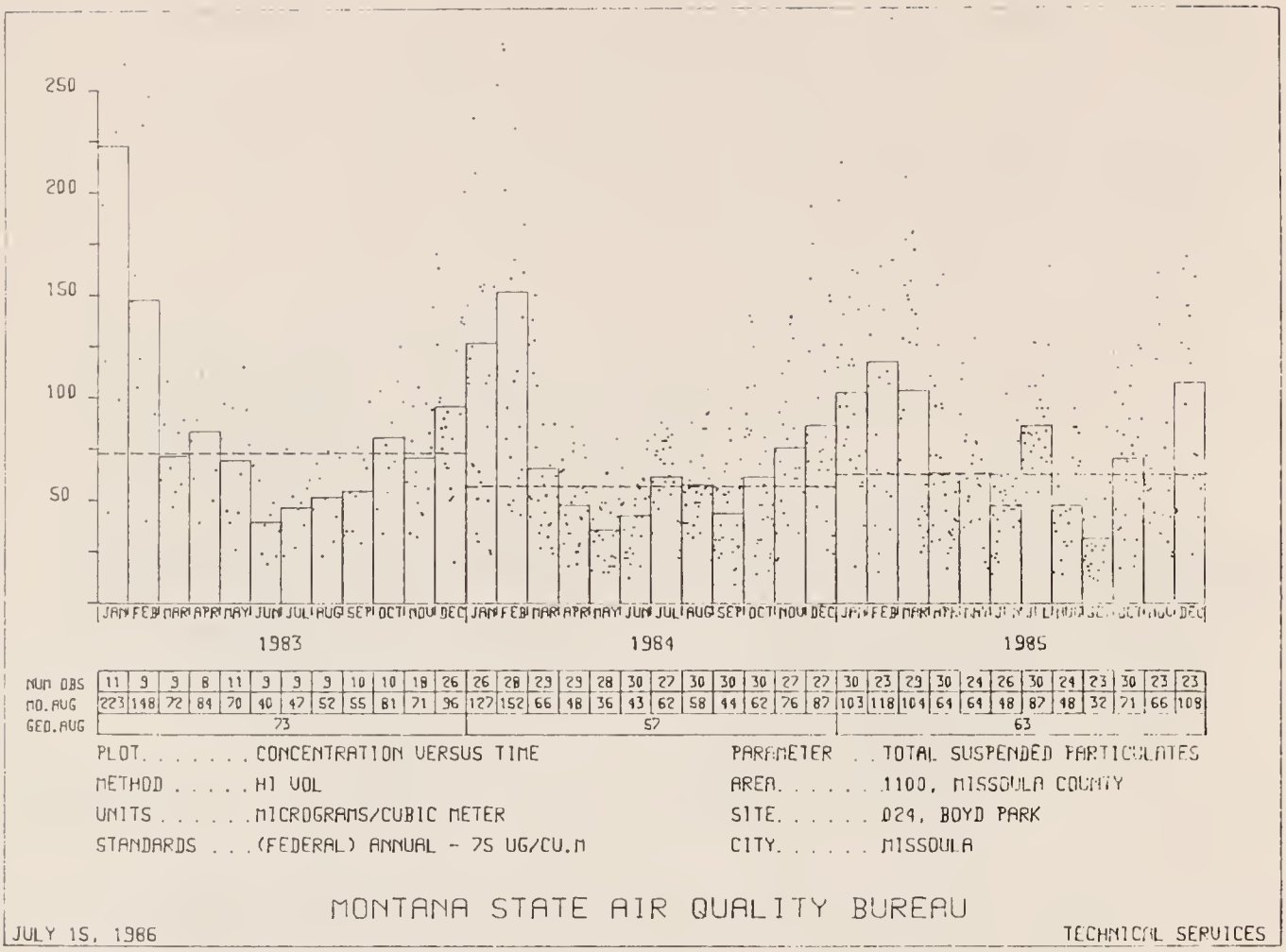
GEO.AVG 56 54 53
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA . . . . . 1100, MISSOULA COUNTY
SITE. . . . . 020, ROSE PARK
CITY. . . . . MISSOULA
MONTANA STATE AIR QUALITY BUREAU
JULY 14, 1986
TECHNICAL SERVICES

county moved the collocated TSP sampler to the Health Department roof site in January, 1985.

10. During 1985, the geometric mean for TSP at Boyd Park was 63 ug/m^3. The two highest twenty-four hour concentrations were 309 ug/m^3 and 301 ug/m^3. These high readings occurred during January and December. The TSP data from Boyd Park continued to exceed the Montana and federal twenty-four hour ambient standards during 1985. In regard to annual average, the Boyd Park site exceeded the federal secondary annual standard. Figure 18 is a three year plot of monthly TSP concentrations at the Boyd Park site.

FIGURE 18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1983
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NUM OBS 11 9 3 8 11 3 3 3 10 10 18 26 26 28 29 29 28 30 27 30 30 30 27 27 30 23 29 30 24 26 30 24 23 30 23 23
MO.AVG 223 148 72 84 70 40 47 52 55 81 71 96 127 152 66 48 36 43 62 58 44 62 76 87 103 118 104 69 69 48 87 48 32 71 66 108
GEO.AVG 73 57 63
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 1100, MISSOULA COUNTY
SITE. . . . . 024, BOYD PARK
CITY. . . . . MISSOULA
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

11. The Missoula County Health Department will continue to operate the Boyd Park site indefinitely. As mentioned earlier, the Missoula County Health Department may, in the future, designate the Boyd Park site as the focus of their episode monitoring program. They believe that the site easily meets all siting criteria and would therefore be representative of a greater geographical area.

12. Missoula County moved the Courthouse Roof site to the City-County Building at 301 Alder during December, 1984. The new location is in the same part of town (two blocks north of the Courthouse) and is more convenient to operate since the Missoula County Health Department offices are in the building. In addition, the roof of the City-County Building is lower than the Courthouse roof and therefore it complies more closely with vertical placement requirements. The new location lies on the boundary between a commercial-light industrial area and a residential area. The City-County Building is the new collocated TSP site in Missoula.

13. The Missoula Health Department site registered a geometric mean of 62 ug/m^3 during 1985. The highest twenty-four hour concentrations were 305 ug/m^3 and 275 ug/m^3. The 1985 TSP levels at the Health Department exceeded all state and federal standards except for the Montana annual standard and the federal primary annual standard.

14. The Missoula County Health Department intends to operate the Health Department site indefinitely. This location appears to be impacted by more re-entrained road dust and less wood smoke than the Rose Park or Boyd Park sites. In addition, the Health Department site is the primary monitoring site north of the Clark Fork River.

15. The Missoula County Health Department has operated a site at the Meadow Hills School in southwest Missoula for almost three years. The site is in a residential area and easily meets all siting criteria. In October, 1984, Missoula County removed the high volume sampler and replaced it with a 15 micron size selective inlet.

16. In 1985, the geometric mean for PM-15 was 38 ug/m^3. Although Missoula County expected PM-15 readings to be lower than TSP levels, this value is considerably lower than the Boyd Park site which is located 1.5 miles northeast. The highest twenty-four hour reading was also much lower than most other Missoula sites at 129 ug/m^3.

17. The Missoula County Health Department will continue to operate this site for at least one more year. Missoula intends to operate the sampler on an every sixth day schedule during the lower particulate months of May through September and then return to an every third day schedule for the remainder of the year. The site will continue to be equipped with a 15 micron size selective inlet sampler unless personnel from EPA Region VIII agree to exchange the 15 micron inlet for a 10 micron inlet.

18. The Spurgin and Tower site was located just south of the Orchard Homes district in the western half of Missoula. The site was on undeveloped land which is part of the Montana Division of Forestry's nursery. There are virtually no emission sources within a quarter of a mile of this site.

19. Missoula County personnel operated this site for over two years. In 1985, the geometric mean was very low at 38 ug/m^3. The highest twenty-four hour reading was 122 ug/m^3. In light of the low readings, Missoula County shut down the Spurgin and Tower site during May, 1986.

20. Missoula County installed a TSP monitor at the Rattlesnake School in October, 1984, but did not collect any valid data until January 1, 1986, due to equipment problems. The Rattlesnake area is situated near the point where the Rattlesnake Canyon opens into the Missoula Valley.

County personnel suspect that wood smoke emissions from the residential areas extending up the canyon drift downslope until particulate levels hit a maximum in this area. Missoula County intends to operate this site for at least one year to develop a sound data base.

21. Missoula County has operated a special purpose monitor at the Mount Jumbo elementary school in East Missoula since January, 1985. East Missoula is separated from Missoula by a constriction in the Clark Fork Valley known as Hellgate Canyon. Missoula County is interested in determining what the TSP levels are in this area. However, Missoula County is not satisfied with the location of this site in regard to meeting siting criteria and will not be submitting data to the department until the site is upgraded.

22. Missoula also operates a temporary high volume sampler near Clinton to measure emissions from the Janey Construction gravel crusher. This special purpose monitor is only operated during the summer and fall and the data is retained for local use.

Hamilton

1. Hamilton is a community of 2600 people lying in the center of the Bitterroot Valley approximately 50 miles south of Missoula. The elevation of Hamilton is 3550 feet or about 300 feet higher than Missoula. Hamilton often experiences much better wintertime ventilation than nearby Missoula. On many occasions, when Missoula is fogged in and experiencing high TSP concentrations, Hamilton is sunny and relatively clear. The department speculates that the downslope drainage winds cause the nighttime cold air to move through Hamilton and pool near Missoula. This cold air is associated with fog which

prevents the sun from reaching the ground and heating up the surface layer of air. However, Hamilton is generally above the cold air layer.

2. The department has operated a high volume sampler on the roof of the Ravalli County Courthouse since January, 1984. The general location of the site is shown in Figure 19. The TSP data is summarized in Table 8 and Figure 20.

3. During 1985, the geometric mean for TSP was 45 ug/m^3. This concentration is quite low for a western Montana community. There were only three twenty-four hour readings over 100 ug/m^3 and they occurred during December, January and March. The seasonal nature of the higher readings points toward residential wood smoke and re-entrained road dust as the major emission sources. The 1985 data from the Ravalli County Courthouse site complied with all Montana and federal ambient standards. Figure 20 is a graphical display of the past three years of data at the Courthouse site.

4. Although the first three years of total suspended particulate data showed relatively low concentrations, the department believes they are high enough to warrant continued particulate monitoring. Since residential wood combustion is suspected to be a significant emission source impacting this site, the department also installed a PM-10 monitor during June, 1986.

Ovando

1. The department operates a western Montana background sampler at the Smith Ranch near Ovando. The Smith Ranch is in the sparsely populated upper Blackfoot Valley. The entire area is used almost exclusively for hay production and livestock grazing.

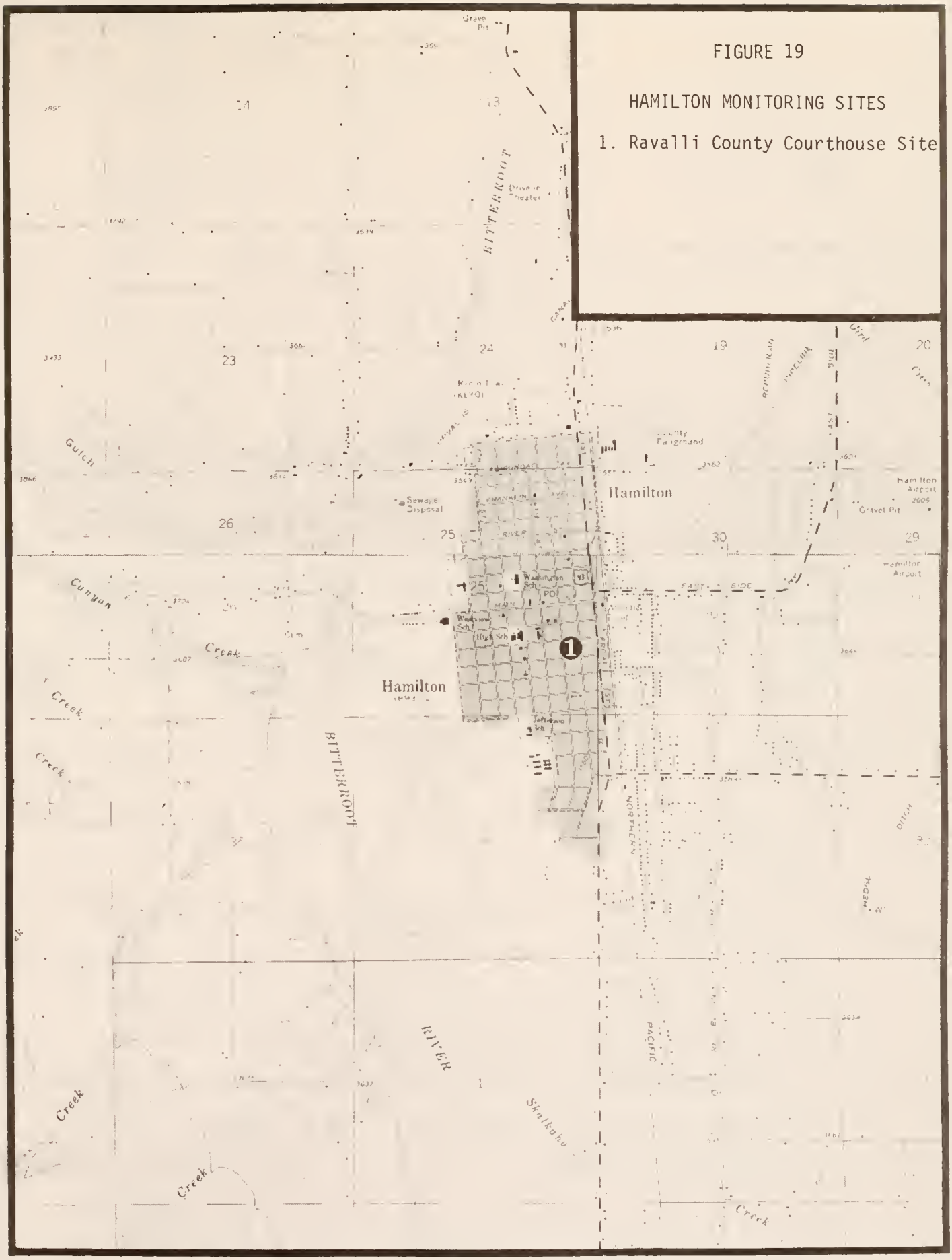
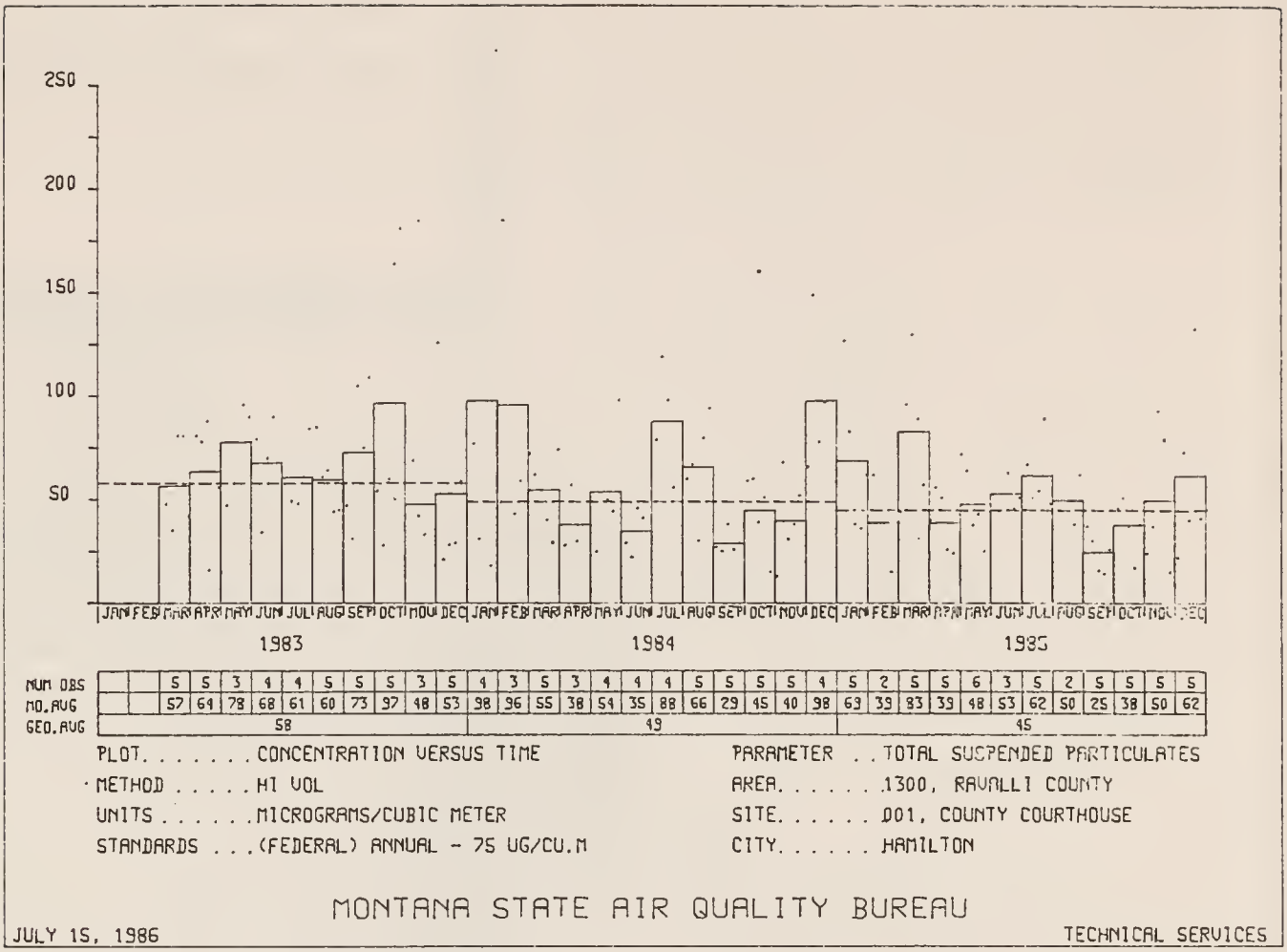


FIGURE 19

HAMILTON MONITORING SITES

1. Ravalli County Courthouse Site

FIGURE 20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NUM OBS 5 5 3 4 4 5 5 5 3 5 4 3 5 3 4 4 4 5 5 5 5 4 5 2 5 5 6 3 5 2 5 5 5 5
MO.AVG 57 64 78 68 61 60 73 97 48 53 98 96 55 38 54 35 88 66 29 45 40 98 63 33 83 33 48 53 62 50 25 38 50 62
GEO.AVG 58 49 45
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 1300, RAVALLI COUNTY
SITE. . . . . 001, COUNTY COURTHOUSE
CITY. . . . . HAMILTON
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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2. Figure 21 shows the location of the site and Table 8 summarizes the associated data.

3. During 1984 and 1985, the geometric means remained the same at 15 ug/m^3. These concentrations are very low and typical of a background site. The highest twenty-four hour concentrations were 104 ug/m^3 and 95 ug/m^3 and they occurred during the summer, similar to past years. The department suspects that fugitive dust sources such as re-entrained road dust and livestock movement are the likely cause of the higher levels during the summer.

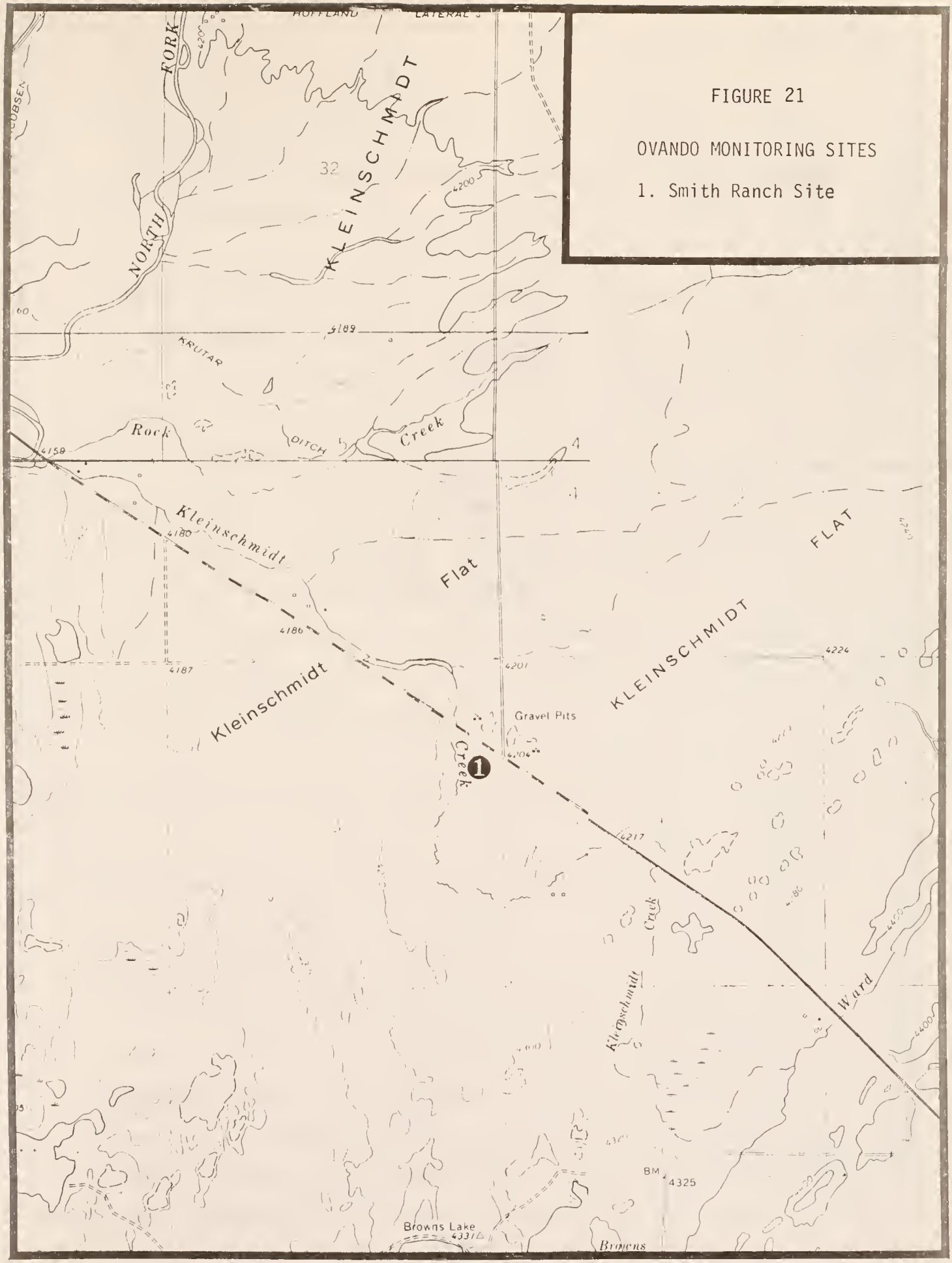


FIGURE 21
OVANDO MONITORING SITES
1. Smith Ranch Site
NORTH FORK
KLEINSCHMIDT
32
KRUTAR
Rock
DITCH
Creek
Kleinschmidt
Flat
KLEINSCHMIDT
FLAT
Kleinschmidt
Gravel Pits
Creek
1
Ward
BM 4325
Browns Lake
4331
Browns

4. The department intends to operate the Ovando site as a background monitor indefinitely. In July, 1985, the department installed a PM-10 monitor at the Ovando site to determine background levels of fine particulates.

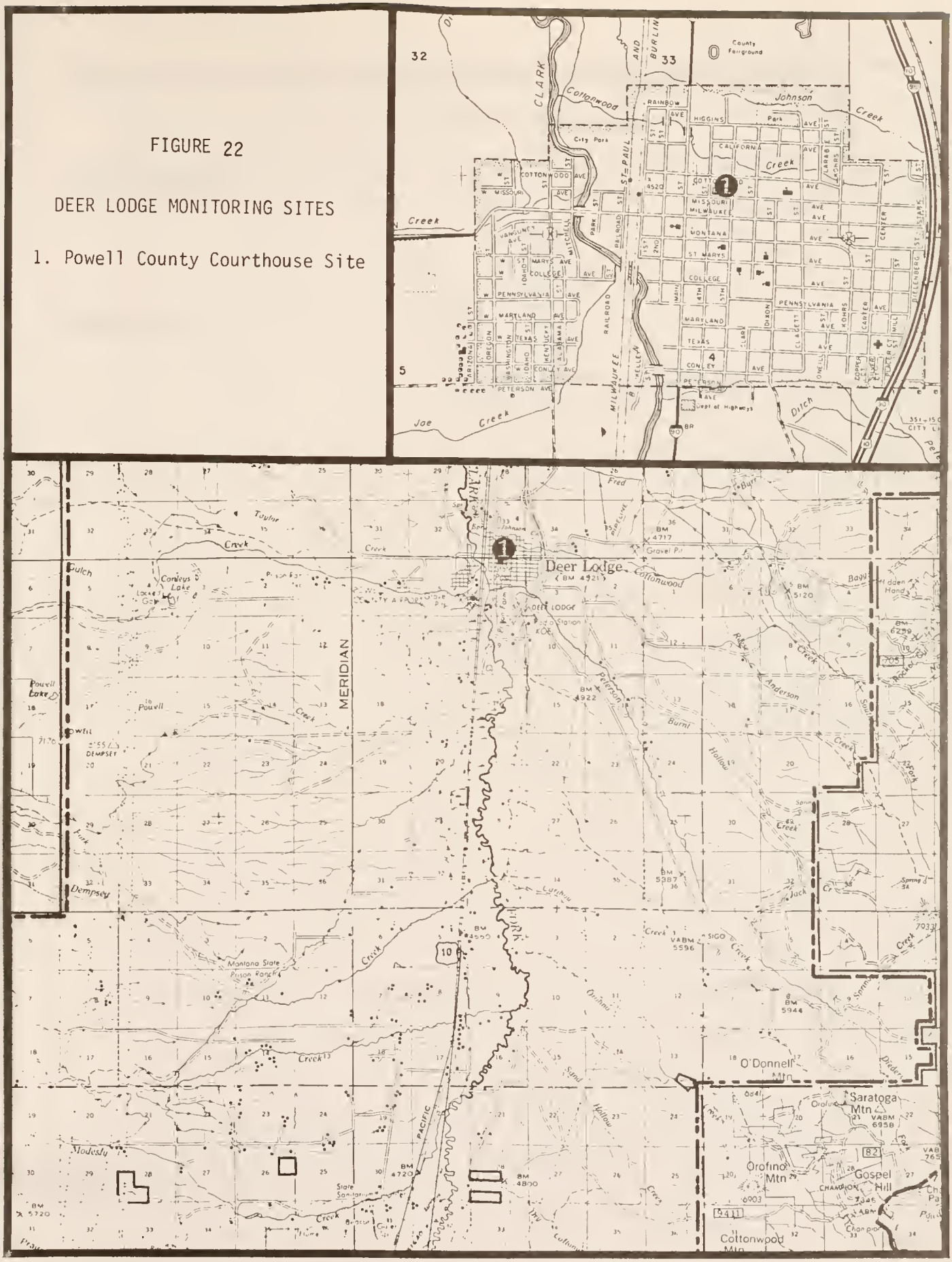
Deer Lodge

1. Deer Lodge is a small town of 4000 people located near the north end of the Deer Lodge Valley. The valley slopes from almost 5300 feet above sea level in the south to 4400 feet in the north. The valley is surrounded by mountains with the 10,000 foot high Flint Creek Range to the west and the 7000 foot Continental Divide to the east.
2. The department began TSP sampling at the Powell County Courthouse in Deer Lodge during July, 1984. The establishment of a site in Deer Lodge was consistent with the 1983 and 1984 Network Reviews which proposed short-term sampling in all western Montana communities with populations over 1000 people. The purpose of the sampling was to determine total suspended particulate concentrations in previously unmonitored communities.
3. Figure 22 shows the monitoring site location and Table 8 summarizes the associated data.
4. The Powell County Courthouse is located in a residential part of town one and one-half blocks off the main street. The immediate area around the Courthouse is comprised of older homes and associated larger trees. The high volume sampler was located on the roof of the Courthouse approximately 40 feet above ground level.
5. The geometric mean for 1985 was 42 ug/m^3 and the highest twenty-four hour concentration was 130 ug/m^3. Both these concentrations are very low and in compliance with all Montana and federal ambient standards.

FIGURE 22

DEER LODGE MONITORING SITES

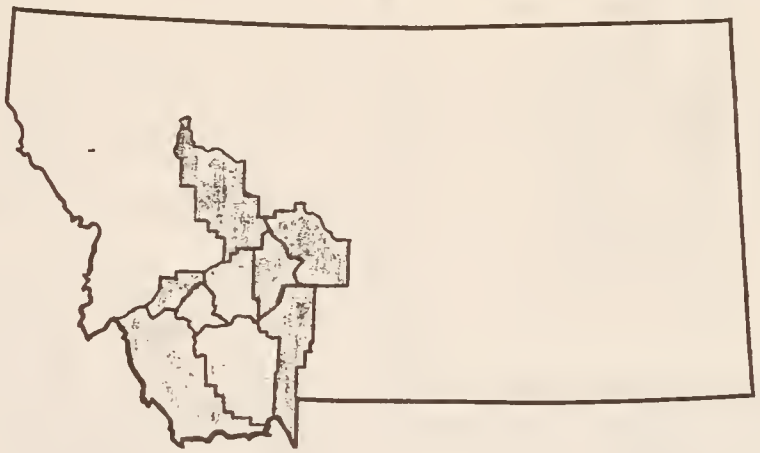
1. Powell County Courthouse Site



6. The department disassembled the Powell County Courthouse site during June, 1986. The department reviewed the data from this site and determined that the levels were very low and did not warrant further monitoring.

SOUTHWEST

MONTANA



Southwest Montana includes Beaverhead, Broadwater, Deer Lodge, Jefferson, Gallatin, Lewis and Clark, Madison, Meagher and Silver Bow Counties. This region of Montana has very high mountains; however, the valleys are considerably wider than the valleys of northwest and west central Montana. Winter dispersion conditions are better than the more western regions, but severe temperature inversions do occur.

Helena

1. The city of Helena is situated near the south end of the Helena Valley. The elevation of the city varies from 3850 feet in the north part of Helena to over 4200 feet at the extreme southern edge of the city. The Helena Valley is meteorologically similar to other western Montana valleys. Prevailing winds are generally light (average - 7.5 mph) and from the southwest, west or northwest directions.
2. Figure 23 shows the location of the Helena sites on a city map while Table 8 summarizes the particulate data.

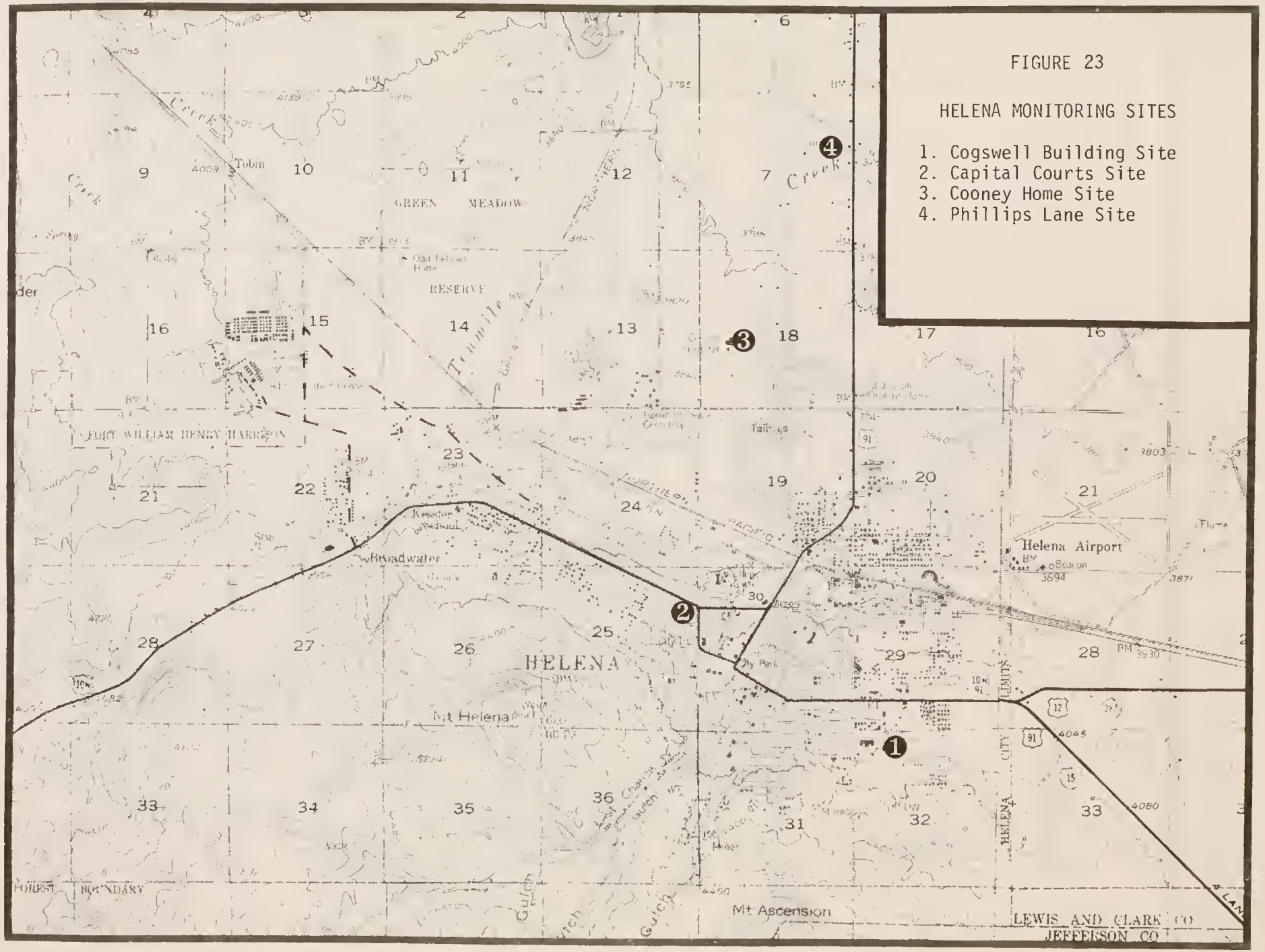


FIGURE 23

HELENA MONITORING SITES

1. Cogswell Building Site
2. Capital Courts Site
3. Cooney Home Site
4. Phillips Lane Site

3. The Cogswell Building site has been the mainstay of the Helena particulate sampling network for ten years. The Cogswell Building is part of the Capitol Complex which lies on the south side of Helena at an elevation of 4120 feet. The area surrounding the Capitol Complex is generally residential with older homes to the west and newer homes to the east. The Prospect and 11th Avenue strip development is located four blocks to the north.

4. In 1985, the geometric mean at the Cogswell Building for total suspended particulates was quite low at 46 ug/m^3. The first and second highest twenty-four hour values were 273 ug/m^3 and 195 ug/m^3. These concentrations are in compliance with all state and federal ambient standards except for the federal secondary twenty-four hour standard.

5. Due to the long historical record at this site and its convenient location, the department recommends that sampling continue at the Cogswell Building. The department also has installed and is operating collocated PM-10 monitors at this site.

6. The Capital Courts site is operated by the Lewis and Clark County Health Department. The high volume sampler is located on the roof of the Capital Courts Athletic Club which is on the north edge of a residential area and one block south of a commercial strip.

7. During 1985, the Capital Courts site registered a geometric mean for TSP of 51 ug/m^3. Although this was the highest geometric mean recorded in Helena during 1985, it is still quite low. TSP data from the Capital Courts site met the state and federal ambient standards for annual average, but exceeded the state primary and the federal secondary standard for twenty-four hour concentrations.

8. The Lewis and Clark County Health Department intends to continue to operate this site. They will also install an additional high volume sampler to facilitate collocated sampling.

9. The Lewis and Clark County Health Department also operated a high volume sampler at the Cooney Rest Home near the north edge of town. The site was at an elevation of 3820 feet which is about the lowest point within the city limits of Helena. The sampler was shut down in October, 1985, because the Cooney Home was scheduled for demolition.

10. The Cooney Home site recorded surprisingly low TSP concentrations during 1985. The geometric mean and maximum twenty-four hour readings of 30 ug/m^3 and 76 ug/m^3 were the lowest values recorded in Helena. Both the maximum twenty-four hour concentration and the geometric mean were lower in 1985 than in 1984.

11. The Lewis and Clark County Health Department is considering establishing a new site in the Helena Valley which would operate for at least one year. The purpose of the site would be to determine if particulate levels are higher in the valley due to downslope settling of cold air and the associated air pollution.

East Helena

1. East Helena is a small community about five miles east of Helena and is the site of the ASARCO lead smelter and the American Chemet paint pigment plant. East Helena is experiencing rapid residential growth along its northern and eastern edges.

2. During 1985, the department, in cooperation with the ASARCO lead smelter, operated five TSP sites in the vicinity of East Helena. The Dartman Field and South sites were operated exclusively by the

department; however, the Hastie, Firehall and Hadfield sites were a joint effort. ASARCO provided day to day operation of the three sites while the department provided most of the equipment, calibrations, filters and filter analyses. The sampling frequency was once every sixth day for the South and Dartman Field sites and once every third day for the other three. Although total suspended particulates are monitored, the primary objective of all five sites is to track lead concentrations around the ASARCO smelter and the American Chemet plant.

3. The locations of the East Helena sites are shown in Figure 24. Table 8 summarizes the associated TSP data.
4. The department performed numerous statistical analyses on the East Helena data during the 1985 Network Review. The TSP and trace metals data was compared by linear regression at each site and between sites. For an indepth analysis readers should refer to that document.
5. The Hastie site is situated on Pacific Street in East Helena just across U.S. Highway 12 from the American Chemet plant and the ASARCO smelter. The Hastie site has operated for over ten years and TSP data from the site was responsible for designating the area nonattainment for primary and secondary TSP standards.
6. In 1985, TSP levels at the Hastie site were in compliance with all state and federal ambient standards. The annual geometric mean was down six percent from 1984 and stood at 49 ug/m^3. The highest twenty-four hour concentration was 173 ug/m^3.
7. The department terminated monitoring at the Hastie site on January 1, 1986. The primary reason for shutting down the site was to save over $4,000.00 annually in laboratory charges. The department identified several other supporting reasons:

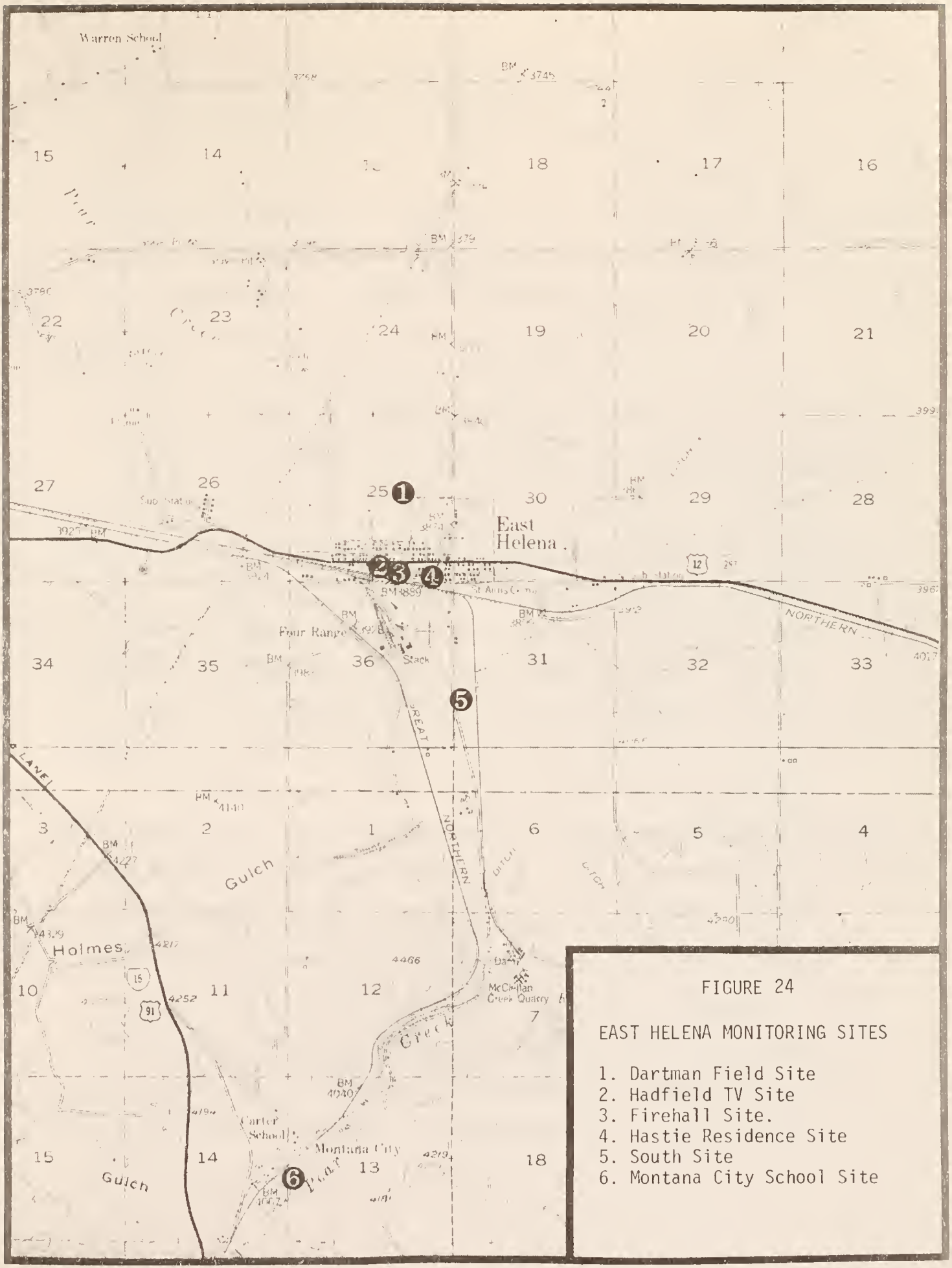


FIGURE 24

EAST HELENA MONITORING SITES

1. Dartman Field Site
2. Hadfield TV Site
3. Firehall Site.
4. Hastie Residence Site
5. South Site
6. Montana City School Site

a. Of the three sites in this part of East Helena, the Hastie site recorded the lowest TSP and lead concentrations during 1983 through 1985.

b. The statistical analyses performed in conjunction with the 1985 Network Review indicated that the TSP and metals data from the Hastie site tracked similar data from the Firehall site, indicating that the Firehall site can adequately monitor this area of town.

c. The Hastie site is slowly being overgrown by nearby trees.

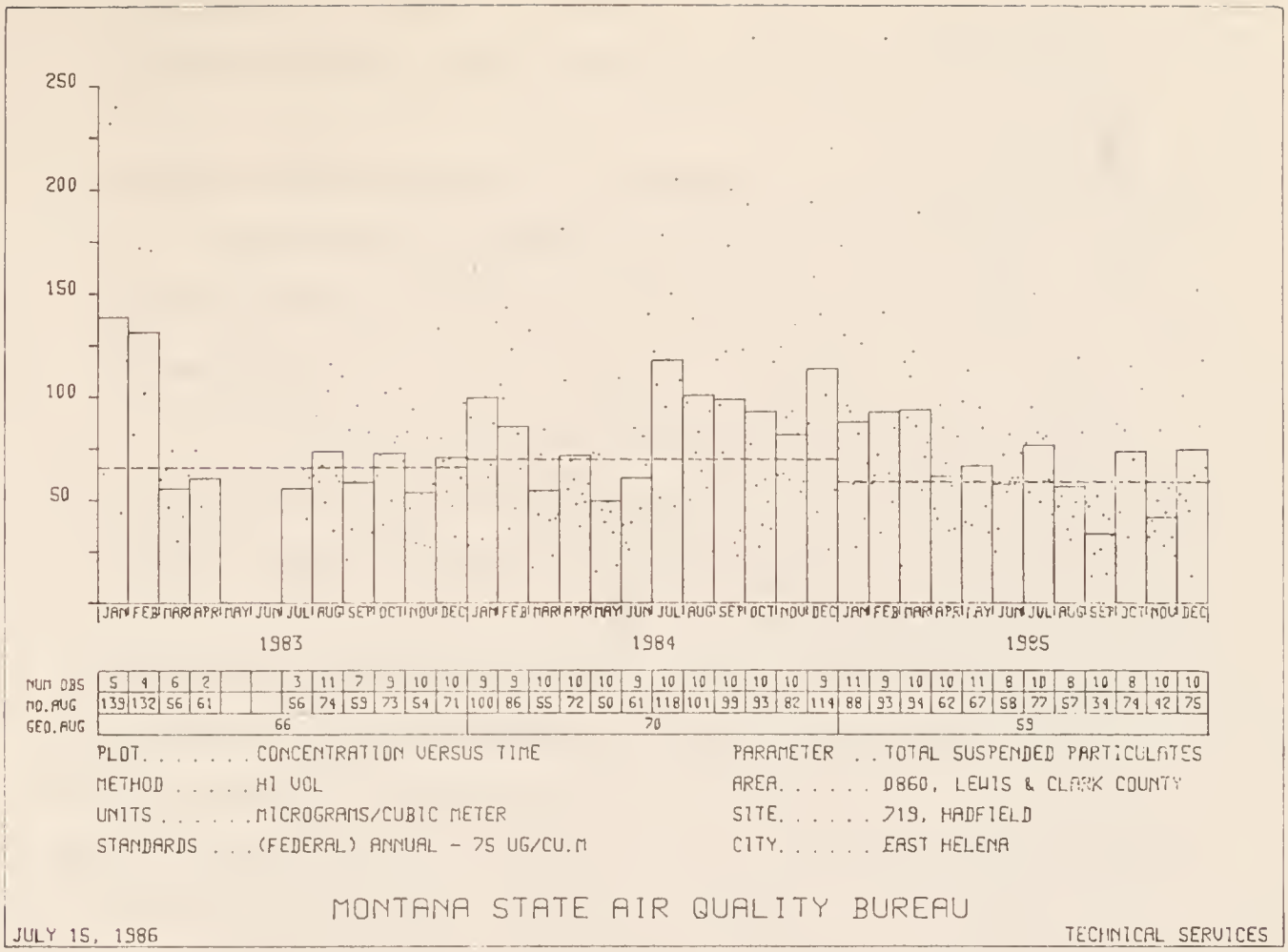
8. The Hadfield site is located just south of the main street of East Helena. The department and ASARCO cooperatively operate collocated high volume samplers at this site.

9. In 1985, TSP concentrations at the Hadfield site complied with all ambient standards except the federal secondary twenty-four hour standard. The highest twenty-four hour concentration was 273 ug/m^3. The annual geometric mean was 59 ug/m^3 and the arithmetic mean was 67 ug/m^3. Figure 25 is a three year plot of TSP levels at the Hadfield site.

10. The department intends to operate the Hadfield site indefinitely. The Hadfield site recorded the highest TSP concentrations in East Helena and is essential for tracking the TSP control plan. It is also a key site for assessing the effectiveness of the East Helena lead control strategies.

11. The Firehall site is located on Pacific Street across Highway 12 from the ASARCO smelter and the American Chemet plant. The site is approximately 1.5 blocks southeast of the Hadfield site. The high

FIGURE 25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1984
1985
NUM OBS 5 9 6 2 3 11 7 9 10 10 9 9 10 10 10 9 10 10 10 10 10 9 11 9 10 10 11 8 10 8 10 8 10 10
MO.AVG 139 132 56 61 56 74 59 73 54 71 100 86 55 72 50 61 118 101 99 93 82 114 88 93 94 62 67 58 77 57 34 74 42 75
GEO.AUG 66 70 59
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0860, LEWIS & CLARK COUNTY
SITE. . . . . 719, HADFIELD
CITY. . . . . EAST HELENA
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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volume sampler is on the roof of the Firehall about 20 feet above ground level. The Firehall site was the key site in designing the lead control strategies for East Helena.

12. In 1985, TSP at the Firehall site registered a geometric mean of 59 ug/m^3, the same as at the Hadfield site. TSP data met both the state and federal annual standards but exceeded the Montana and federal secondary twenty-four hour standards. The 1985 geometric mean was down 11 percent from 1984. The highest individual readings were 215 ug/m^3 and 204 ug/m^3.

13. The department and ASARCO will continue to operate the Firehall site indefinitely to track the effectiveness of the lead and TSP control strategies.

14. The Dartman Field site is located in a field just north of East Helena. The site is about 0.75 miles from the ASARCO smelter complex.

15. During 1985, TSP levels at the Dartman Field site met all state and federal ambient standards. The geometric mean was 36 ug/m^3 and the highest twenty-four hour concentration was 113 ug/m^3.

16. Although TSP levels at the Dartman Field site are low, lead values are relatively high. The department will operate the Dartman Field site for at least another year.

17. The South site was located in a field approximately 0.75 miles south-southeast of the ASARCO smelter. The primary land use in the area is agriculture, although much of the land is unused open space. The site was operated primarily to determine lead concentrations resulting from the ASARCO stack and plant fugitive dust. Prevailing winds are from the west and northwest and, therefore, the South site is downwind of the smelter complex.

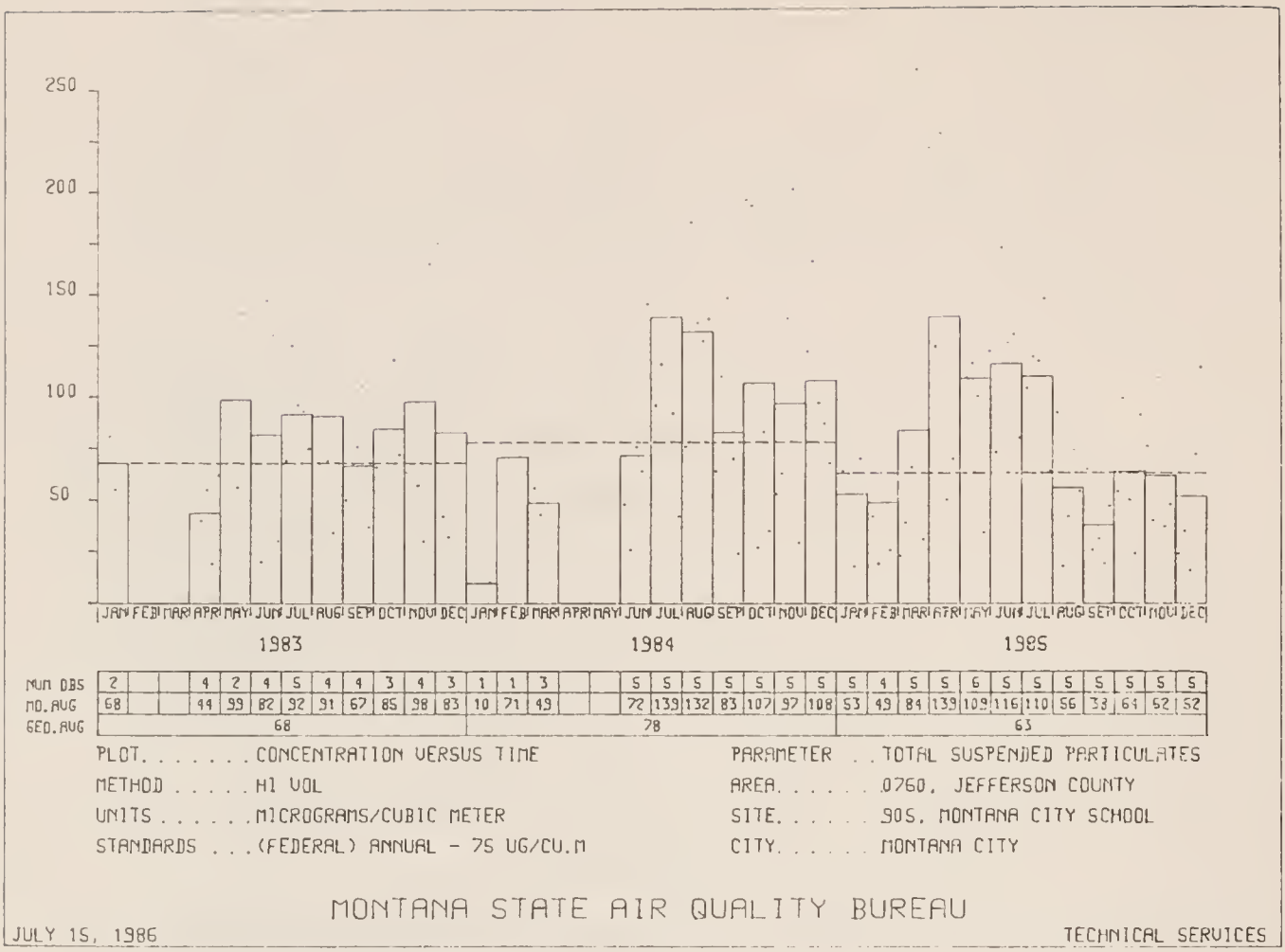
18. During the first four months of 1985, TSP levels remained very low at the South site. The geometric mean was 31 ug/m^3 and the highest twenty-four hour reading was 92 ug/m^3. The TSP data was in compliance with all state and federal ambient standards.

19. The department shut down the South site in April, 1985. Although the statistical analysis conducted in the 1985 Network Review indicated that the South site is impacted by a different set of emission sources, the TSP and lead concentrations were quite low. In an effort to save money on laboratory charges, the department shut down the site.

Montana City

1. Montana City was a late nineteenth century mining camp which has totally disappeared. However, the name Montana City has been kept alive and describes an I-15 interchange, a local grade school and a store-bar-restaurant complex. The timbered hills to the south have been intensively subdivided over the past ten years for residential home sites.
2. The department has operated a high volume sampler on the roof of the Montana City School since February, 1982. The school is located approximately 0.3 miles west-southwest of the Kaiser Cement Plant and near the intersection of secondary highway 518 and the Saddle Mountain Road. The Saddle Mountain Road is unpaved and has an average daily traffic of approximately 600 cars. This road serves the expanding subdivisions on the slopes of Saddle Mountain.
3. Figure 24 identifies the location of the Montana City School site and Table 8 summarizes the associated TSP data.
4. TSP levels during 1985 remained quite high although the geometric mean decreased by 19 percent from 1984. The annual geometric mean of 63 ug/m^3 exceeded the federal secondary TSP ambient standards. The first and second highest twenty-four hour readings were 259 ug/m^3 and 228 ug/m^3. These concentrations exceeded the state primary and the federal secondary standards, but met the federal primary standard. Figure 26 is a three-year plot of TSP concentrations at the Montana City School.
5. The department suspects that the high TSP levels are caused by re-entrained dust off the Saddle Mountain Road and, to a lesser extent, emissions from the Kaiser Cement mine and plant. Wood smoke from nearby homes may also be a contributor during the winter season.

FIGURE 26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JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
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NUM OBS 2 4 2 4 5 4 4 3 4 3 1 1 3 5 5 5 5 5 5 5 5 4 5 5 6 5 5 5 5 5 5 5
MO.AVG 68 44 99 82 92 91 67 85 98 83 10 71 49 72 139 132 83 107 97 108 53 49 84 139 109 116 110 56 33 64 52 52
GEO.AVG 68 78 63
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0760, JEFFERSON COUNTY
SITE. . . . . 905, MONTANA CITY SCHOOL
CITY. . . . . MONTANA CITY
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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6. The department intends to operate this site for at least another year. The department will perform some very basic source apportionment work at the Montana City School site over the next twelve months. Based on the results, the department will develop control strategies to bring the area into compliance with ambient standards. In addition, the department intends to initiate PM-10 monitoring at this location when an additional PM-10 sampler becomes available.

Anaconda

1. Anaconda is a city of 10,000 people situated at the south end of the Deer Lodge Valley. With the closure of the Anaconda Company smelter in 1980, the population of Anaconda has decreased and is expected to continue to decline. The department anticipates that particulate emissions will follow the population trend, despite higher emissions from the various tailings ponds and demolition of the smelter complex.
2. Figure 27 is a map of Anaconda showing the locations of the various monitoring sites. Table 8 summarizes the particulate data.
3. The Lincoln School monitoring site is located in an older residential area just east of the city center. Until June, 1986, the department and ARCO both operated high volume samplers at this site. In June, the department shut down and removed its sampler to save money and eliminate a duplication of effort.
4. During 1985, the geometric mean for TSP at the Lincoln School was 46 ug/m^3. The highest twenty-four hour value was 245 ug/m^3. There were no violations of state or federal ambient standards during 1985 except for the federal secondary twenty-four hour standard. Figure 28 displays graphically the last three years of TSP data from the Lincoln School site.
5. The department re-established the Highway Junction site during July, 1984. The department reactivated the site in response to public complaints of blowing tailings and flue dust from the smelter demolition project. The Highway Junction site is located near the intersection of Highways 10A, 48 and 273. The site is about one mile northeast of the old smelter complex and two miles east of Anaconda.

FIGURE 27

ANACONDA MONITORING SITES

1. Lincoln School
2. Wheels and Deals
3. Highway Junction
4. Wolfe Residence

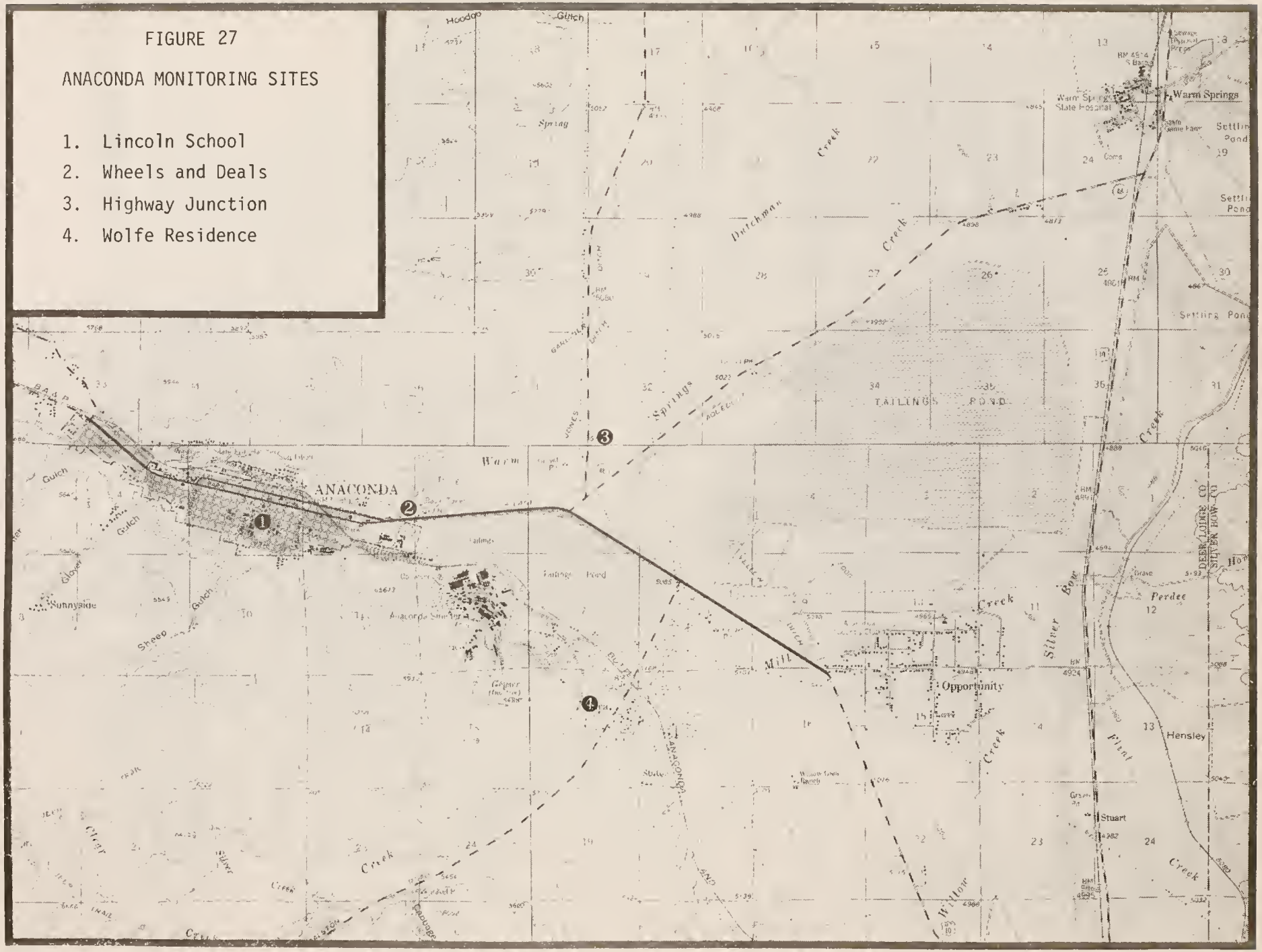
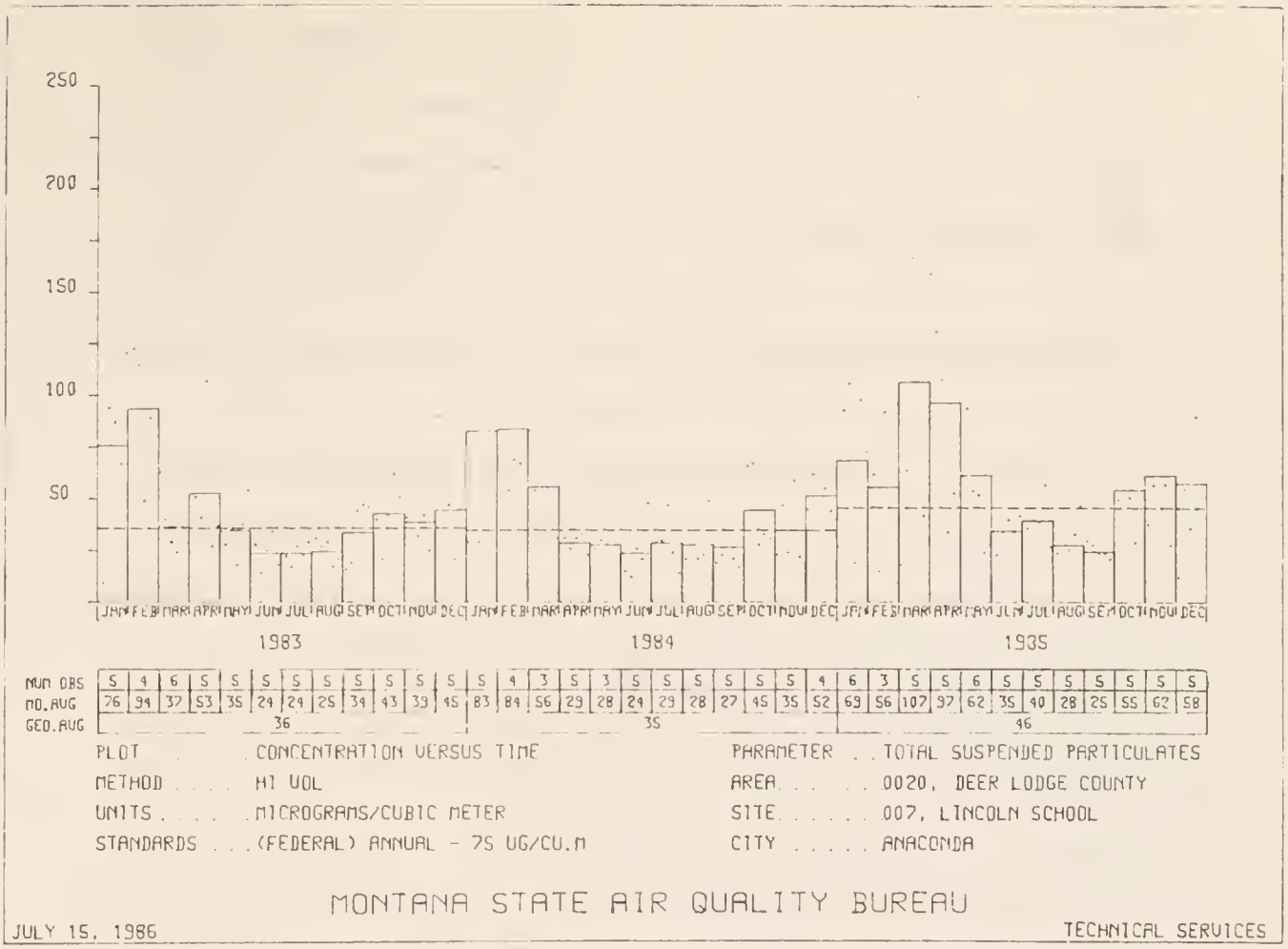


FIGURE 28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1983
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NUM OBS 5 4 6 5 5 5 5 5 5 5 5 5 5 4 3 5 3 5 5 5 5 5 5 4 6 3 5 5 6 5 5 5 5 5 5 5
MO.AVG 76 94 32 53 35 24 24 25 34 43 33 45 83 84 56 29 28 24 29 28 27 45 35 52 69 56 107 97 62 35 40 28 25 55 62 58
GEO.AVG 36 35 46
PLOT . . CONCENTRATION VERSUS TIME
METHOD . . . . HI VOL
UNITS . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA . . . . 0020, DEER LODGE COUNTY
SITE . . . . . 007, LINCOLN SCHOOL
CITY . . . . ANACONDA
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

The Anaconda tailings ponds are one-fourth mile south of the site and the Opportunity tailings pond lies one mile to the east.

6. During 1985, the geometric mean was 23 ug/m^3. The first and second highest twenty-four hour concentrations were 151 ug/m^3 and 73 ug/m^3. These concentrations were drastically lower than the highest twenty-four hour TSP levels recorded in 1984. The reduction is probably due to the reduction of demolition activity at the old Anaconda smelter and new controls on other fugitive dust sources.

7. The department will operate the Highway Junction site for at least two more years. The primary purpose is to check arsenic concentrations in relation to the dismantling of the Anaconda smelter.

8. In June, 1986, the department installed two new TSP samplers in the Anaconda area. These sites were also established at the request of local citizens and the Environmental Protection Agency to monitor arsenic emissions from the flue dust vault and a pile of flue dust located near the old main gate. The flue dust near the main gate will be processed or transported to the vault facility during the summer of 1987.

9. These sites are operated under a cooperative agreement between the department, ARCO and EPA. The department provided and installed the equipment, while an EPA contractor performs the day to day filter changing. ARCO made arrangements with a private laboratory and is funding the laboratory analysis which includes TSP and trace metals.

10. The Wheels and Deals site is located on the roof of a used car sales office across Highway 10A from the main gate flue dust pile. In the near future, the site may be relocated a short distance to the east to minimize the impact of re-entrained road dust from a nearby gravel road. The gravel road receives a fair amount of traffic since it is the access road to the city landfill.

11. The second site is known as the Wolfe Residence site and is located at the foot of the hill immediately below the flue dust vault. EPA believes that this area is being impacted by a larger amount of arsenic-laden flue dust than the ARCO Mill Creek site, which is located 300 yards to the east. EPA has conducted several studies in the Mill Creek area and has determined that arsenic levels are high enough to present unacceptable chronic health risks to the residents. As a result, EPA is offering temporary relocation for the residents while

temporary arsenic clean-up of the area is being completed. Permanent solutions to the contamination are still being studied.

12. Both the Wheels and Deals site and the Wolfe Residence site will be operated until all the flue dust is in the vault and the vault has been sealed and covered.

13. The Anaconda Company will also continue to operate high volume samplers and inhalable particulate samplers at the Lincoln School, Mill Creek, and Johnson Curve sites. The Anaconda Company will analyze the filters for seven chemical elements.

Butte

1. The city of Butte is situated on the north end of the Summit Valley (5400 feet) and extends up the north hill to the city of Walkerville. The Anaconda Minerals Company shut down their Berkeley Pit copper mine and Weed Concentrator in July, 1983. The shutdown not only eliminated a major emission source of particulates, but also had a drastic effect on the local economy. However, mining and ore processing resumed in Butte during August, 1986, under new ownership.

2. Figure 29 shows the location of the Butte sampling site. Table 8 summarizes the associated particulate data.

3. In 1983, the department reduced the Butte monitoring network from four sites to only the Greeley School site. The Greeley School is located near the lowest point in the valley (5430 feet). It lies in a residential area 0.3 mile from the Anaconda Company crusher and 0.6 mile from the Berkeley Pit. The department used the data from this site to designate the area nonattainment for primary TSP standards.

4. In 1985, the geometric mean for TSP at the Greeley School increased 28 percent to 55 ug/m^3. This increase reversed a four year trend of

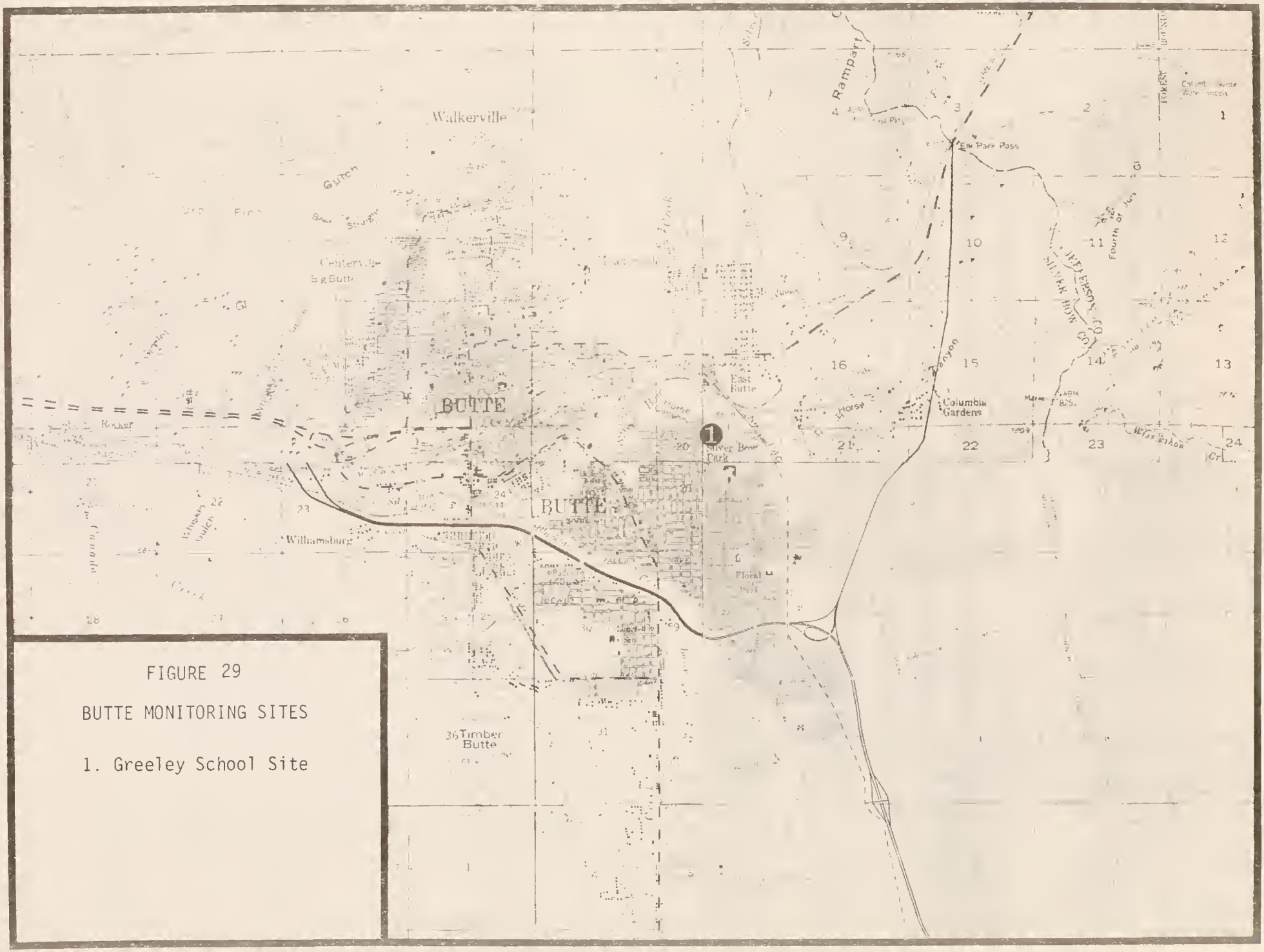


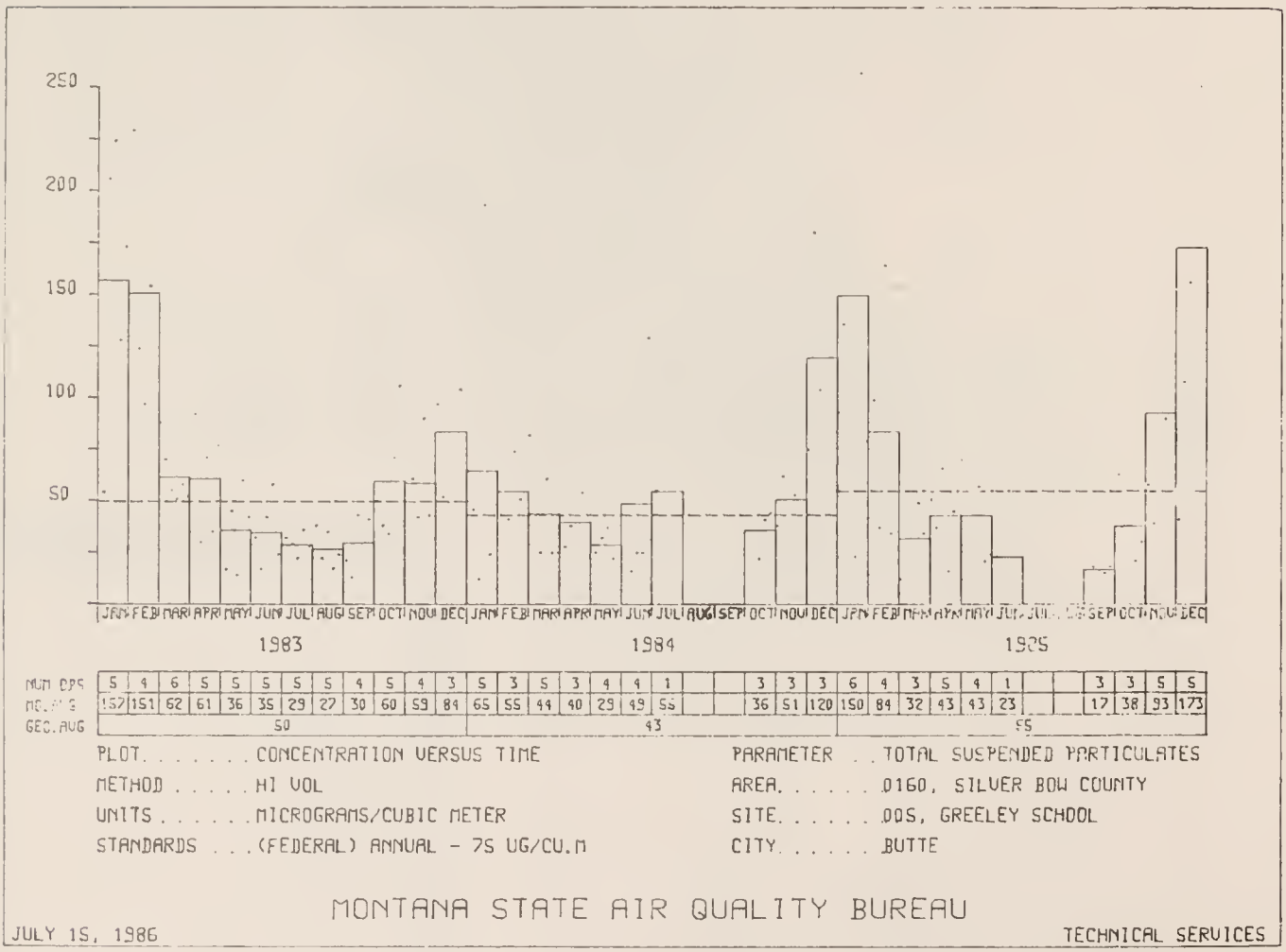
FIGURE 29

BUTTE MONITORING SITES

1. Greeley School Site

decreasing TSP levels. The highest twenty-four hour readings were 314 ug/m^3 and 308 ug/m^3. The Greeley School data indicates compliance with both the Montana and federal annual standards; however, the state and federal twenty-four hour standards were exceeded. Figure 30 graphically presents the TSP data for the last three years. During 1985, the department submitted a request to EPA to redesignate the area to attainment for primary standards. In light of the 1985 data, EPA will not be considering the request and the department has submitted a new analysis of the problem for SIP purposes.

FIGURE 30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1983
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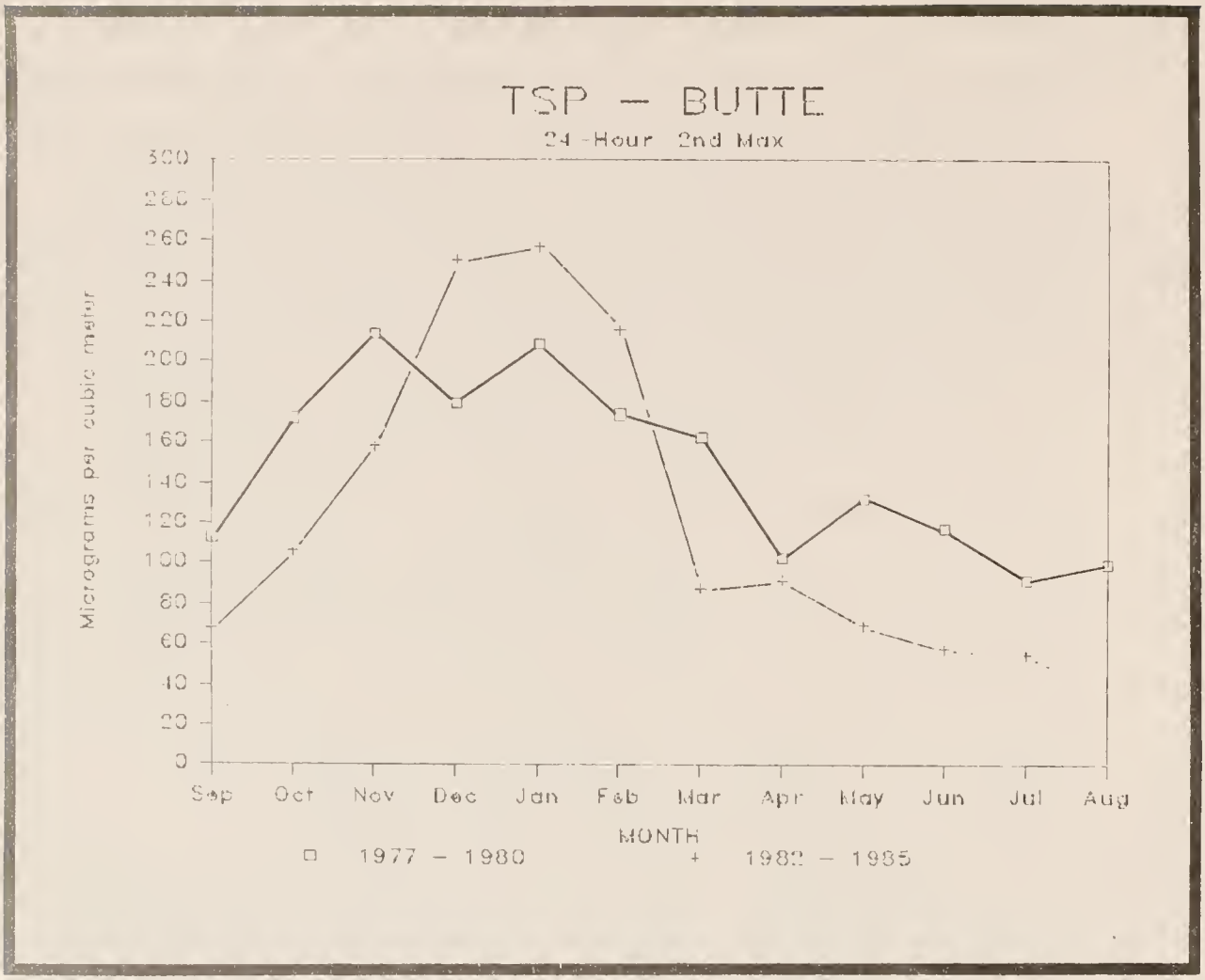
1985
NUM OBS 5 4 6 5 5 5 5 5 4 5 4 3 5 3 5 3 4 4 1 3 3 3 6 4 3 5 4 1 3 3 5 5
MEAN 152 151 62 61 36 35 29 27 30 60 59 84 65 55 44 40 29 49 55 36 51 120 150 84 32 43 43 23 17 38 93 173
GEO.AVG 50 43 55
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0160, SILVER BOW COUNTY
SITE. . . . . 005, GREELEY SCHOOL
CITY. . . . . BUTTE
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

5. Figure 31 displays the monthly concentration of TSP at the Greeley School for the three year period before the shutdown of the Anaconda operation and the three years after the shutdown. The TSP patterns for the two periods are drastically different. During the winter the TSP levels have substantially increased and during the snow-free months, the levels have dropped. The department is convinced that the shutdown of the mine and concentrator essentially eliminated the emissions from the Anaconda operation on a year-round basis. The department also suspects that the increase in TSP during the winter is caused by emissions from residential wood combustion. The original TSP plan for Butte required emission controls for two major emission sources: 1) the Anaconda Minerals Company and 2) the City of Butte (road dust). In light of the above discussion, the department will need to modify the Butte plan to address wood stove emissions in order to assure compliance with Montana and federal ambient standards.

6. Over the past few years, other areas of Montana have recorded higher TSP levels than Butte. Therefore, the department moved the Greeley School collocated sampler to Libby. The department intends to continue to operate the Greeley School site indefinitely and to add a second high volume sampler to facilitate every third day sampling during October, 1986. The department also intends to initiate a mutagen screening analysis of TSP filters as of November 1, 1986. In addition, the department installed a PM-10 monitor during May, 1985.

7. In December, 1985, Washington Construction Inc. purchased all the Anaconda Minerals Company's holdings in Butte and in August, 1986,

FIGURE 31



Montana Resources, Inc., a subsidiary of Washington Construction, reopened the Butte ore processing facilities and a new Continental Pit. Montana Resources, Inc.'s air quality permit requires them to conduct TSP monitoring at four locations: the Hillcrest site, the Belmont mine, near the Yankee Doodle tailings pond, and east of the Continental Pit. In addition, they are required to analyze the filters from these sites as well as the State's Greeley School site for lead, arsenic, copper and cadmium.

Dillon

1. Dillon is a town of 4000 people set in the middle of the Beaverhead Valley. The valley floor is at 5400 feet above sea level with relatively low (6700 feet) rolling mountains located ten miles to the west. Although higher mountain ranges such as the Pioneer, Snow Crest and Ruby Ranges are nearby, Dillon projects a wide open spaces image. The only major industrial emission sources in the area are the Pfizer talc plant and the Stoltze sawmill which are both located six miles south of town.
2. Figure 32 shows where the Dillon monitoring site was and Table 8 summarizes the TSP data.
3. In accordance with the 1984 Network Review, the department installed a high volume sampler at the Beaverhead County Courthouse. The department started sampling in late September, 1984. The Beaverhead County Courthouse is located two blocks southeast of the downtown area and one-half block off the old highway. The sampler is located on the Courthouse roof about 20 feet above the ground.
4. The geometric mean for the last four months of 1985 was 45 ug/m^3 and the highest twenty-four hour reading was 112 ug/m^3. These readings are quite low and indicate that Dillon does not have a particulate problem.
5. With almost two years of monitoring data available, the department shut down the Dillon site in June, 1986. The department felt that the low readings did not warrant further monitoring.

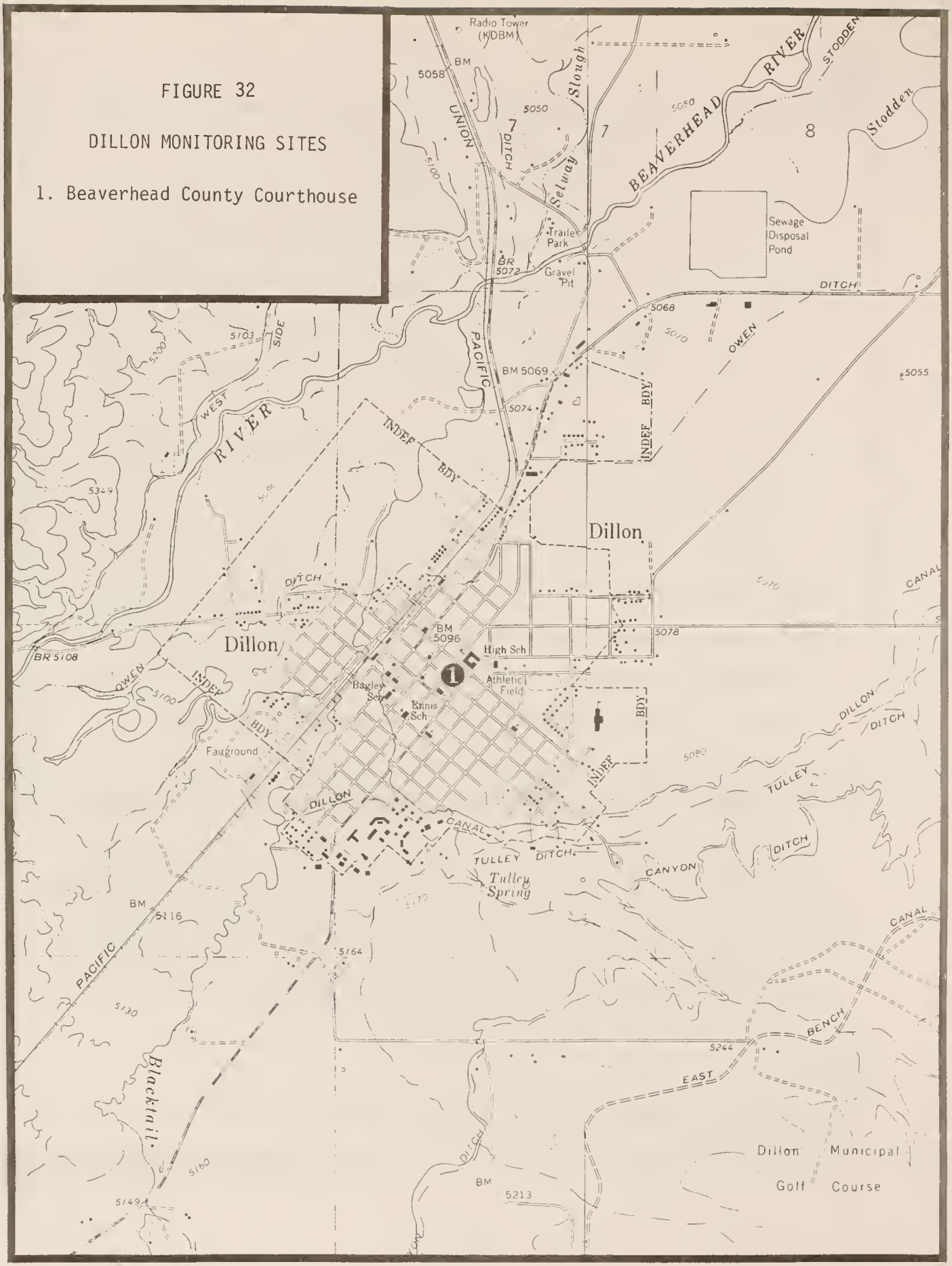
Bozeman

1. The city of Bozeman lies near the eastern edge of the Gallatin Valley at an elevation of 4800 feet above sea level. The Gallatin Valley

FIGURE 32

DILLON MONITORING SITES

1. Beaverhead County Courthouse



experiences frequent temperature inversions. The department believes this phenomenon is aggravated by the confinement of surrounding mountains and a high rate of radiation surface cooling caused by the city's high elevation and persistent winter snow cover.

2. Figure 33 is a map showing the locations of the Bozeman sampling sites. Table 8 summarizes the associated TSP data.

3. The East Main City Building site is the primary sampling site in Bozeman. The East Main City Building is located one-half block north of Main Street near the east end of the central business district. The Hawthorne School lies directly to the north with an older residential area beyond.

4. The 1985 geometric mean at the East Main site decreased 19 percent to 56 ug/m^3. The highest individual readings were 202 ug/m^3 and 153 ug/m^3. Although the federal primary standards and the Montana annual standard were not exceeded, the federal twenty-four hour secondary standard was. Figure 34 is a graphical representation of the last three years of TSP data from the East Main site.

5. The department will continue to operate this site indefinitely. The department upgraded the site during 1985 by installing a permanent electrical outlet near the sampler. This eliminated unexpected power losses caused by people unplugging the sampler to plug in their car heaters. The department will add a second high volume sampler at the East Main site during the fall of 1986. The additional sampler will allow the department to increase the sample frequency to every third day sampling and thereby better assess the compliance status of the area. The department also intends to begin mutagen screening on the

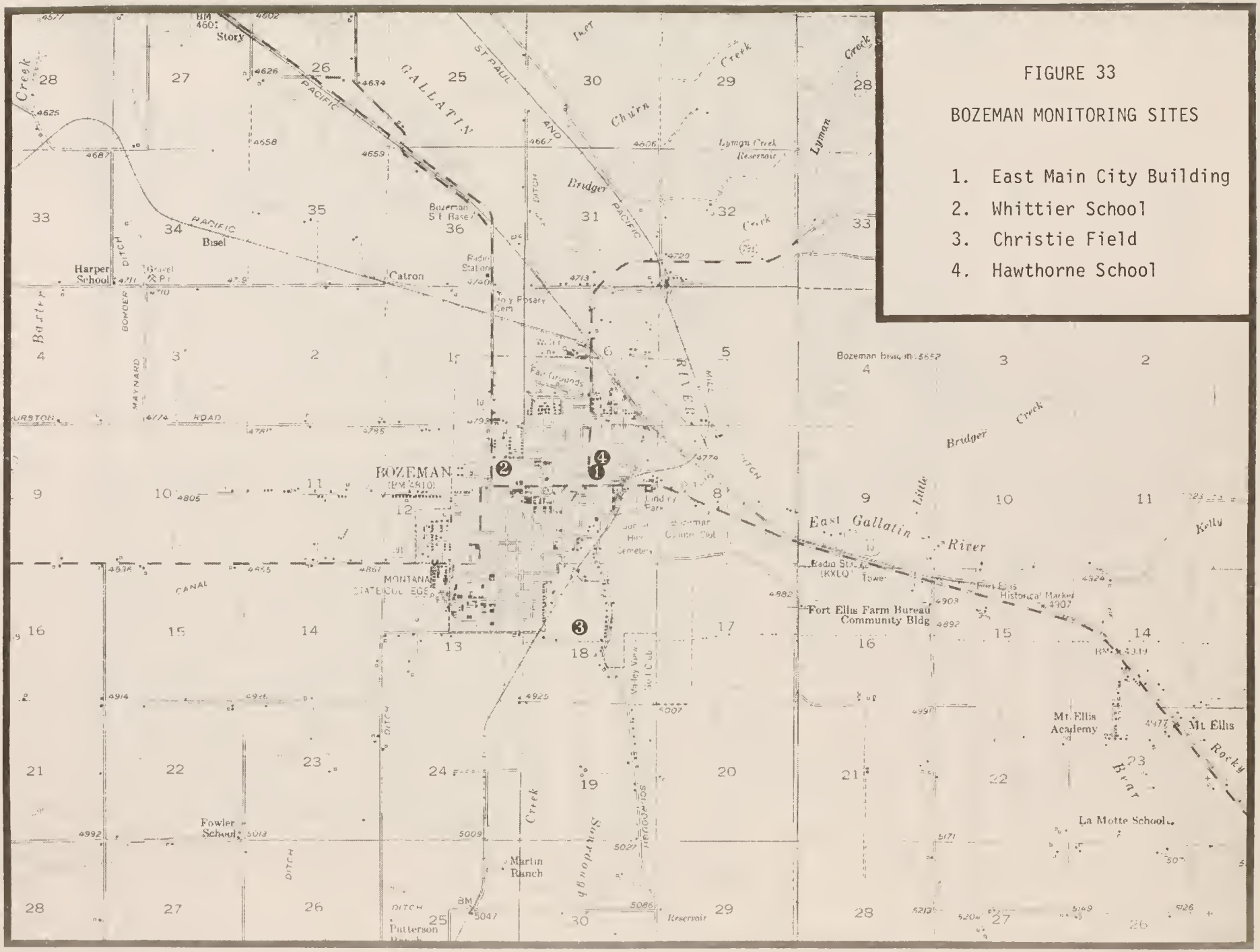
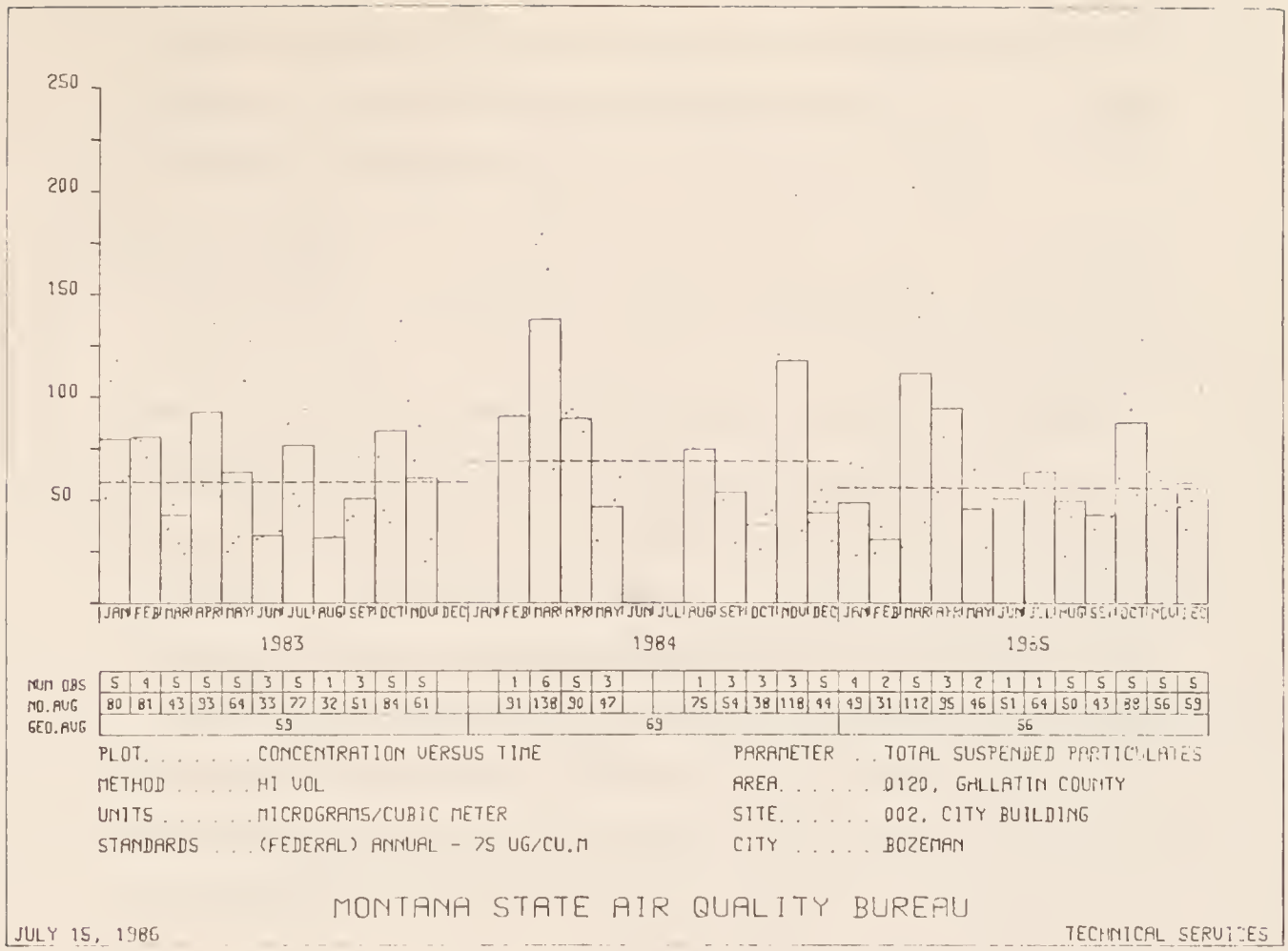


FIGURE 33

BOZEMAN MONITORING SITES

1. East Main City Building
2. Whittier School
3. Christie Field
4. Hawthorne School

FIGURE 34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1985
NUM OBS 5 4 5 5 5 3 5 1 3 5 5 1 6 5 3 1 3 3 3 5 4 2 5 3 2 1 1 5 5 5 5 5
NO.AVG 80 81 43 93 64 33 77 32 51 84 61 31 138 90 97 75 54 38 118 44 43 31 112 35 46 51 64 50 43 88 56 59
GEO.AVG 59 69 56
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0120, GALLATIN COUNTY
SITE. . . . . 002, CITY BUILDING
CITY . . . . . BOZEMAN
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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TSP samples during the fall of 1986. In addition, the department installed a PM-10 monitor at this site during July, 1985.

6. The Whittier School site was located on the west edge of a residential area and one block east of Seventh Avenue, which is a major arterial.

7. During the first six months of 1985, TSP concentrations at the Whittier School site remained the same as in 1984. The geometric mean was 57 ug/m^3 and the highest twenty-four hour value was 176 ug/m^3. The data complied with all state and federal ambient standards except the federal secondary twenty-four hour standard.

8. In July, 1985, the department moved the Whittier School site to a new location at the Christie Field Park near the Sourdough Creek area. The department and Gallatin County personnel are interested in monitoring in the Sourdough Creek area to establish TSP levels in a residential area with intensive residential wood burning. The area lies in a small valley along Sourdough Creek where light drainage winds tend to concentrate smoke.

9. The geometric mean at the Christie Field site for the last six months of 1985 was surprisingly low at 30 ug/m^3. The highest twenty-four hour reading was also very low at 62 ug/m^3. The low TSP levels recorded to date indicate that Bozeman's particulate problem may be limited to a small geographical area near the central business district and that perhaps wood stove emissions are not as significant as predicted.

10. The department will continue to monitor at the Christie Field site at least until two full years of data have been gathered. At that time, the data will be reviewed and the department will decide whether to continue to monitor at this location.

11. A citizens group supervised by the Gallatin County Sanitarian's Office operated two high volume samplers to obtain daily TSP data during the winter and early spring of 1985 and 1986. The TSP data did not meet federal or state quality assurance requirements and was not entered into the state data bank, but it was used in conjunction with a voluntary emergency episode program. The citizens group made the latest TSP data available to the media and on high concentrations days asked for voluntary cutbacks in residential wood burning and automobile

travel. The citizens group expects to run a similar program during the winter of 1986-87 and eventually establish an official county air pollution control program.

Prospective Sites

1. The department will add West Yellowstone to its list of prospective sites even though the department prioritized this network change quite low. The actual establishment of a site at West Yellowstone will depend on the availability of funding and personnel time.
2. The West Yellowstone area is a major tourist area, serving as the west entrance to Yellowstone National Park. The department suspects that residential wood burning and re-entrained road dust may be causing elevated TSP concentrations. Therefore, the department is proposing a monitoring location (see Figure 35) near the edge of the central business district to strike a balance between maximum concentrations and population exposure.

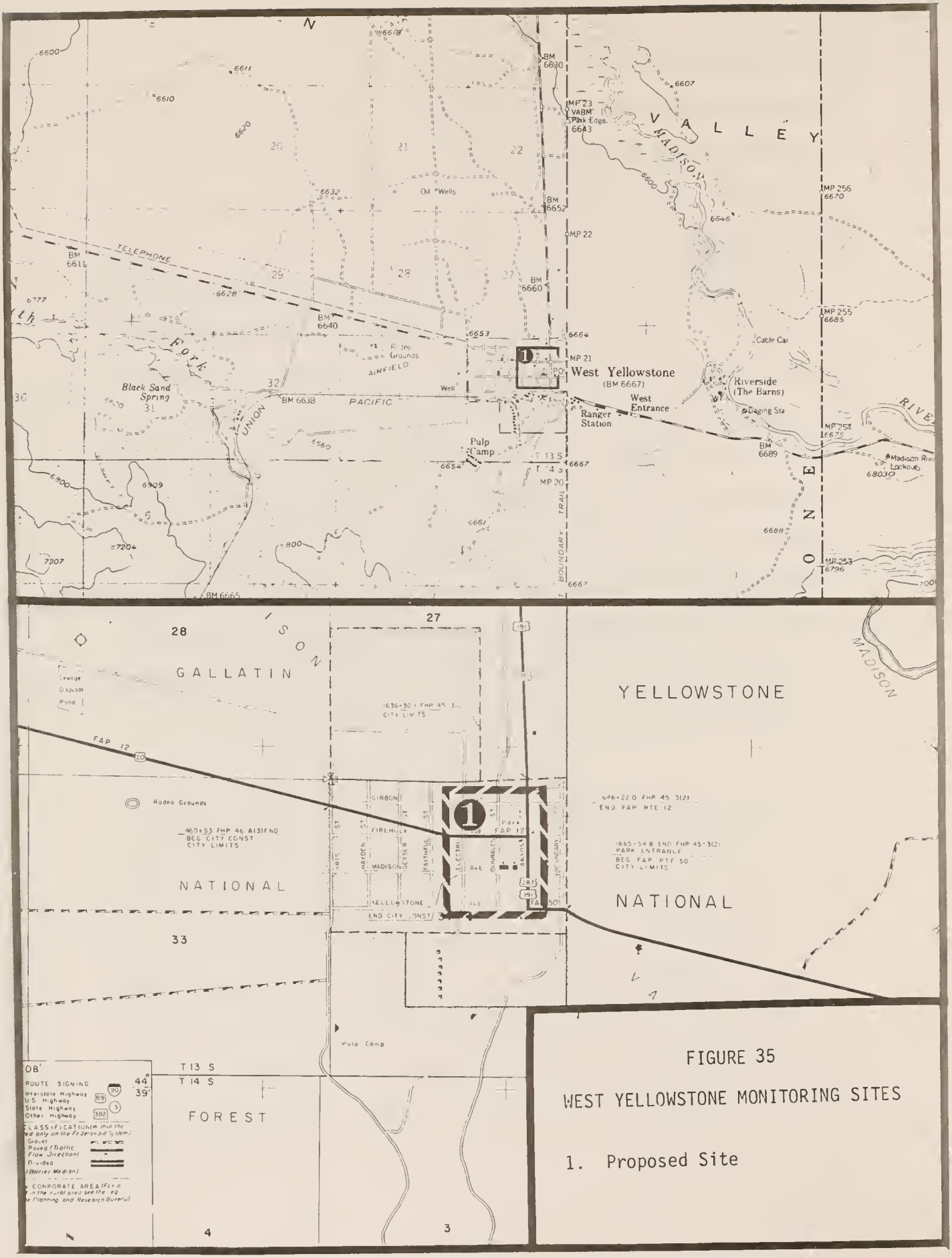


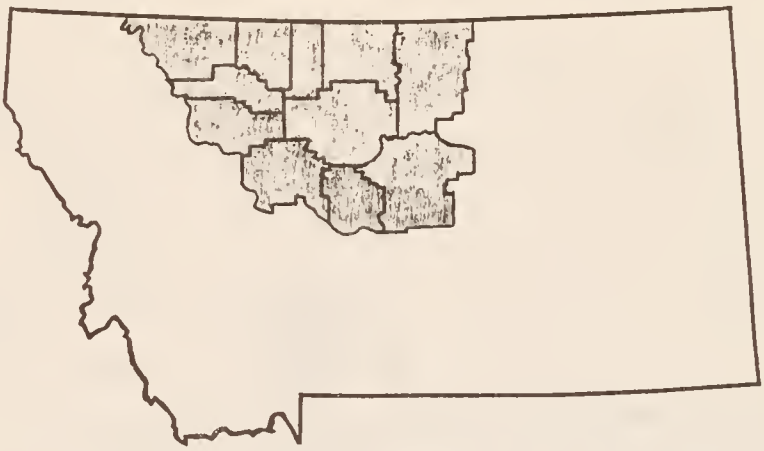
FIGURE 35

WEST YELLOWSTONE MONITORING SITES

1. Proposed Site

NORTH CENTRAL

MONTANA



Northcentral Montana includes the area from Havre and Lewistown west to the Rocky Mountain Front. This region is primarily a high plain used for growing wheat and barley and for grazing cattle. The plain is occasionally interrupted by river and stream drainages and several outlying mountain ranges such as the Bear Paw, Highwood and Judith Mountains. The climate is hot and dry in the summer, and cold and dry in the winter. The notorious "chinook" winds are very prevalent in this area during the late fall and winter. Temperature inversions are infrequent and dispersion conditions are usually good.

Great Falls

1. The Cascade County Health Department operates three high volume sampling sites in Great Falls. The city of Great Falls lies along the banks of the Missouri River near the western edge of the Northern Great Plains. High concentrations of air pollutants are uncommon in Great Falls due to persistent winds.

2. Figure 36 shows the Great Falls sites and Table 8 summarizes the associated data.
3. The Great Falls Fire Station site is located on the southern edge of the downtown central business district. Since the prevailing winds are from the southwest, this site is generally upwind of the downtown area.
4. The Fire Station recorded the highest geometric mean (66 ug/m^3) for total suspended particulate of any of the Great Falls sites. The highest twenty-four hour reading was 264 ug/m^3. The 1985 TSP levels at the Fire Station site were in compliance with federal primary ambient standards. However, the federal secondary and the Montana primary standards were exceeded. Figure 37 graphically displays the Fire Station TSP data for the last three years.
5. The Cascade County Health Department will continue to operate the Fire Station monitor for the foreseeable future. The site usually records the highest concentrations in Great Falls and is essential for tracking the city's progress toward meeting federal secondary standards and Montana primary standards.
6. Cascade County operates a collocated TSP monitoring site on the roof of the library. This NAMS site is known as the Downtown site and is located just north of the downtown business district.
7. In 1985, the geometric mean remained the same as in 1984 at 46 ug/m^3. TSP levels are quite low and meet all state and federal ambient standards.
8. The County will continue to operate the Downtown site, mainly because it is a NAMS site. Otherwise, the low concentrations don't warrant further monitoring. In addition, a PM-10 monitor was installed during October, 1985.

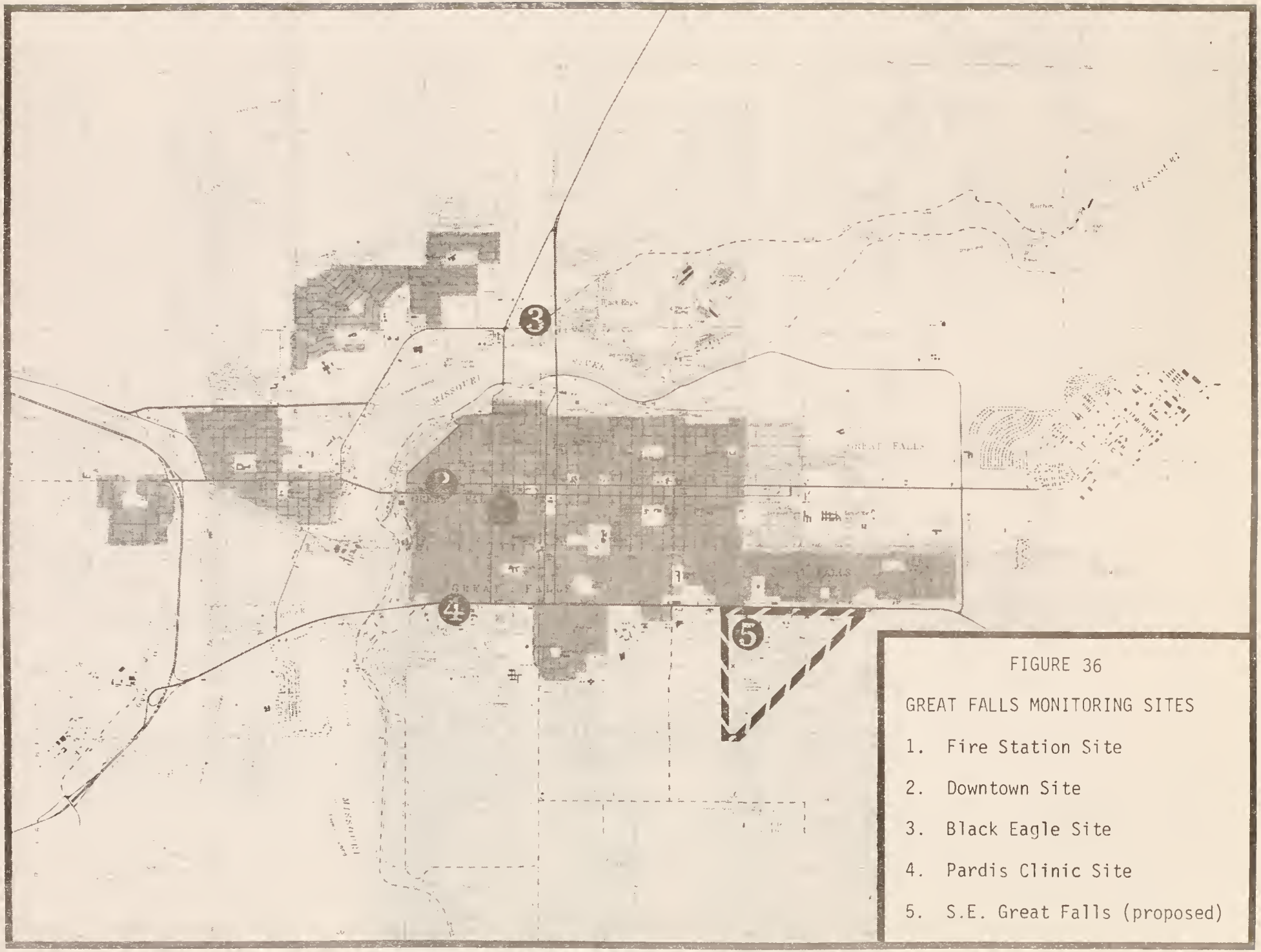
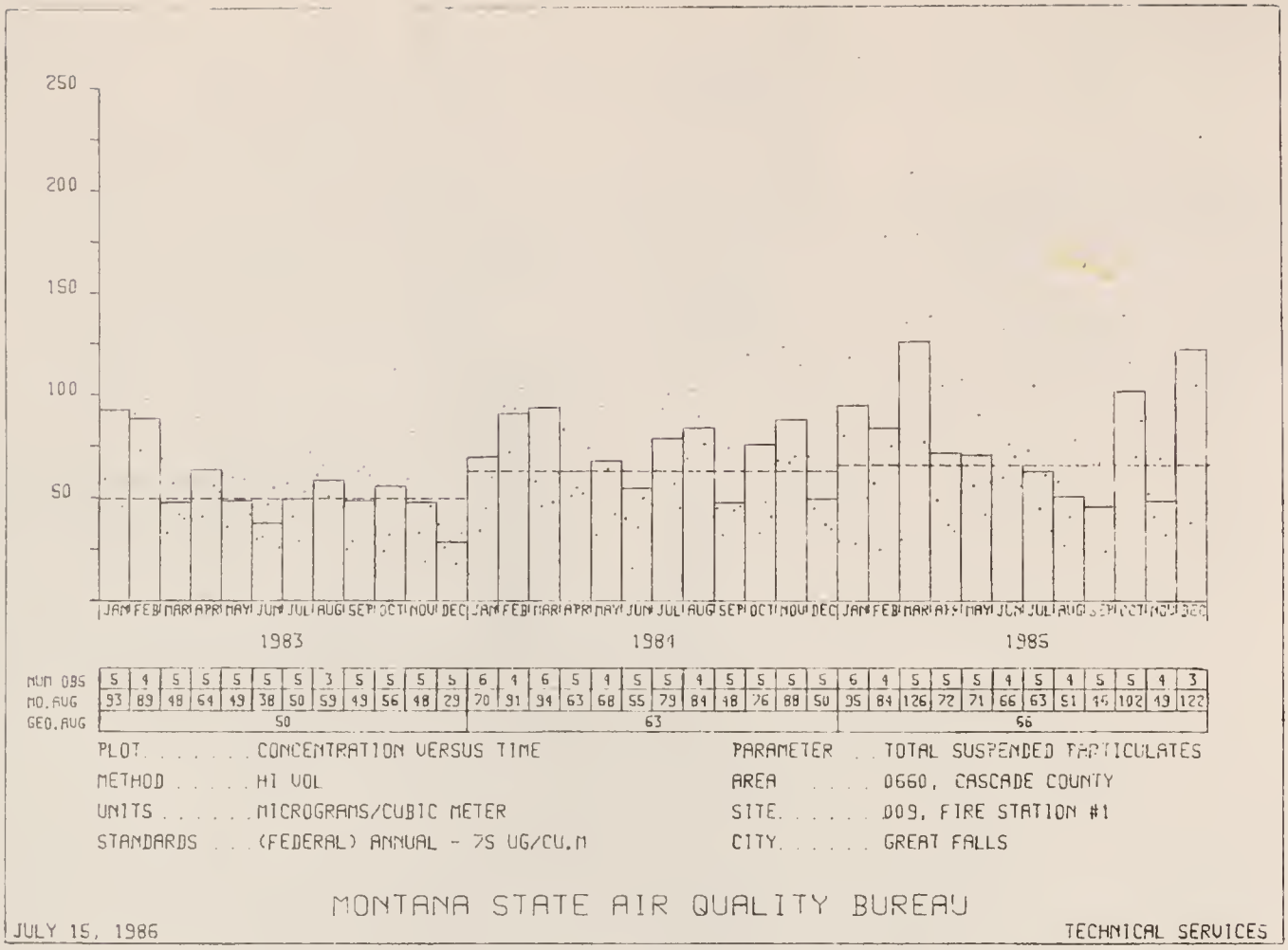


FIGURE 36

GREAT FALLS MONITORING SITES

1. Fire Station Site
2. Downtown Site
3. Black Eagle Site
4. Pardis Clinic Site
5. S.E. Great Falls (proposed)

FIGURE 37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1985
NUM OBS 5 4 5 5 5 5 5 3 5 5 5 5 6 4 6 5 4 5 5 4 5 5 5 5 6 4 5 5 5 4 5 4 5 5 4 3
MO.AVG 93 89 48 64 49 38 50 59 49 56 48 29 70 91 94 63 68 55 79 84 48 76 88 50 95 84 126 72 71 66 63 51 45 102 49 122
GEO.AVG 50 63 66
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA . . . . 0660, CASCADE COUNTY
SITE. . . . . 009, FIRE STATION #1
CITY. . . . . GREAT FALLS
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
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9. The Black Eagle station is located north of the Missouri River in a predominantly industrial area. The Montana Refining Company oil refinery is located 0.5 mile to the west and the demolished ARCO copper refinery was 1.0 mile to the east. The surrounding area has poorly maintained roads and very little vegetative cover. The demolition of the copper refinery was completed in 1984 and, therefore, the 1985 data is the first data not being impacted by this source.

10. The TSP levels at the Black Eagle Post Office were essentially the same as in 1984. Although the geometric mean decreased 5 percent to 53 ug/m^3, the highest individual reading increased 28 percent to 225 ug/m^3. The data from the site complied with federal primary standards

but exceeded the Montana twenty-four hour standard and the federal secondary twenty-four hour standard.

11. Cascade County will continue to operate the Black Eagle site for at least one more year. Despite the completion of the demolition of the ARCO copper refinery, the TSP data has remained relatively high, and Cascade County believes continued monitoring is warranted.

12. The Cascade County Health Department still plans to install a high volume sampler in the southeast part of the city. Although the original preferred location is no longer under consideration, the area is experiencing residential growth and perhaps particulate emissions are increasing.

Choteau

1. The department moved the BLM Malta site to the south fork of the Teton River, 30 miles northwest of Choteau, Montana. The sampler was located in a grassy area on the grounds of the Circle 8 Guest Ranch. The surrounding area is very mountainous and free of emission sources. The sampler was installed during April, 1985, to establish baseline concentrations and to monitor future oil and gas development.

2. Figure 38 shows the location of the Circle 8 Guest Ranch and Table 8 summarizes the associated data.

3. During the last nine months of 1985, the geometric mean at the Circle 8 Guest Ranch was very low at 14 ug/m^3. This concentration is typical of background concentrations throughout Montana. The highest twenty-four hour value was also very low at 41 ug/m^3.

FIGURE 38

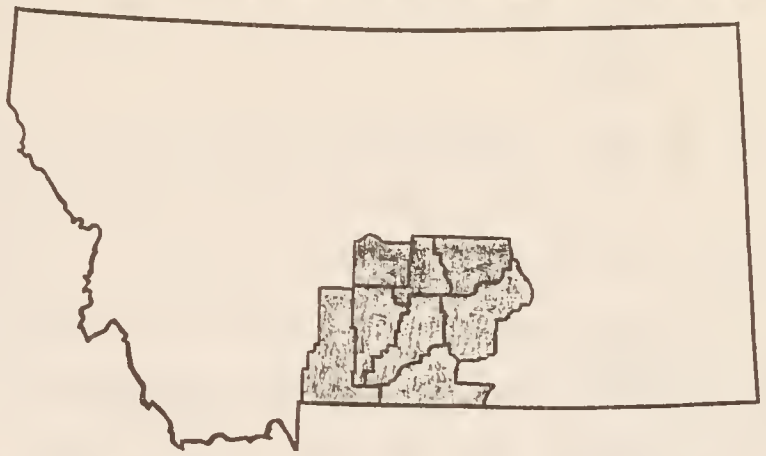
CHOTEAU MONITORING SITES

1. Circle 8 Guest Ranch Site

4. The Circle 8 Guest Ranch site was shut down in January, 1986, and removed in June, 1986. The BLM decided to eliminate the site after the department suggested that the BLM contract with a private firm to operate the site. The department made the suggestion because of continuing difficulties associated with obtaining spending authorities.

SOUTH CENTRAL

MONTANA



Southcentral Montana includes Park, Sweetgrass, Wheatland, Golden Valley, Stillwater, Carbon, Musselshell, Yellowstone, and Bighorn Counties. The area is quite similar to northcentral Montana in regard to climate and physical features. The Yellowstone River, however, has carved a major valley from Livingston to northeast of Billings. The high mountains just north of Yellowstone National Park also are unique to this region.

Billings

1. Billings is located in the bottom of the Yellowstone Valley at an elevation of 3100 feet above sea level. On the north and south edges of the valley, the rimrocks rise abruptly to a height of about 600 feet above the valley. The Yellowstone Valley is approximately ten miles wide near Laurel (12 miles west-southwest of Billings) but the rimrocks form a constriction in the valley at the eastern edge of Billings. The constriction is about one mile wide and separates Billings from the Lockwood area. The prevailing winds are from the southwest and are channeled down the Yellowstone Valley. Although the winds are usually responsible for good atmospheric dispersion, the 1981-1982 Billings

sulfur dioxide study indicated that temperature inversions are quite frequent.

2. Figure 39 shows the locations of the Billings area monitoring sites while Table 8 summarizes the associated data.

3. The Yellowstone County Air Pollution Control Agency operates a high volume sampler at the Grand Avenue School which lies just south of Grand Avenue and the associated commercial strip development. Until January, 1986, the sampler was located on the roof of the school. During November, 1985, the Taft School sampling shelter was moved to the track field just east of the Grand Avenue School and in January, the Grand Avenue high volume sampler was moved to the roof of the new shelter.

4. During 1985, TSP levels at the Grand Avenue site decreased 7 percent to a geometric mean of 54 ug/m^3. The highest twenty-four hour concentration was 237 ug/m^3. The 1985 TSP data from the Grand Avenue School was in compliance with all state and federal ambient standards except for the federal secondary twenty-four hour standard.

5. Yellowstone County personnel will operate the Grand Avenue School site indefinitely to track TSP levels in this portion of Billings. In addition, a PM-10 monitor was installed at this site and became operational in June, 1986. Yellowstone County and the department also designated this a NAMS site for TSP since the old NAMS site at Taft School was eliminated.

6. The City Hall site is located on the roof of the City Hall in downtown Billings. This site was responsible for the nonattainment designation of the central business district. Emission inventories and associated

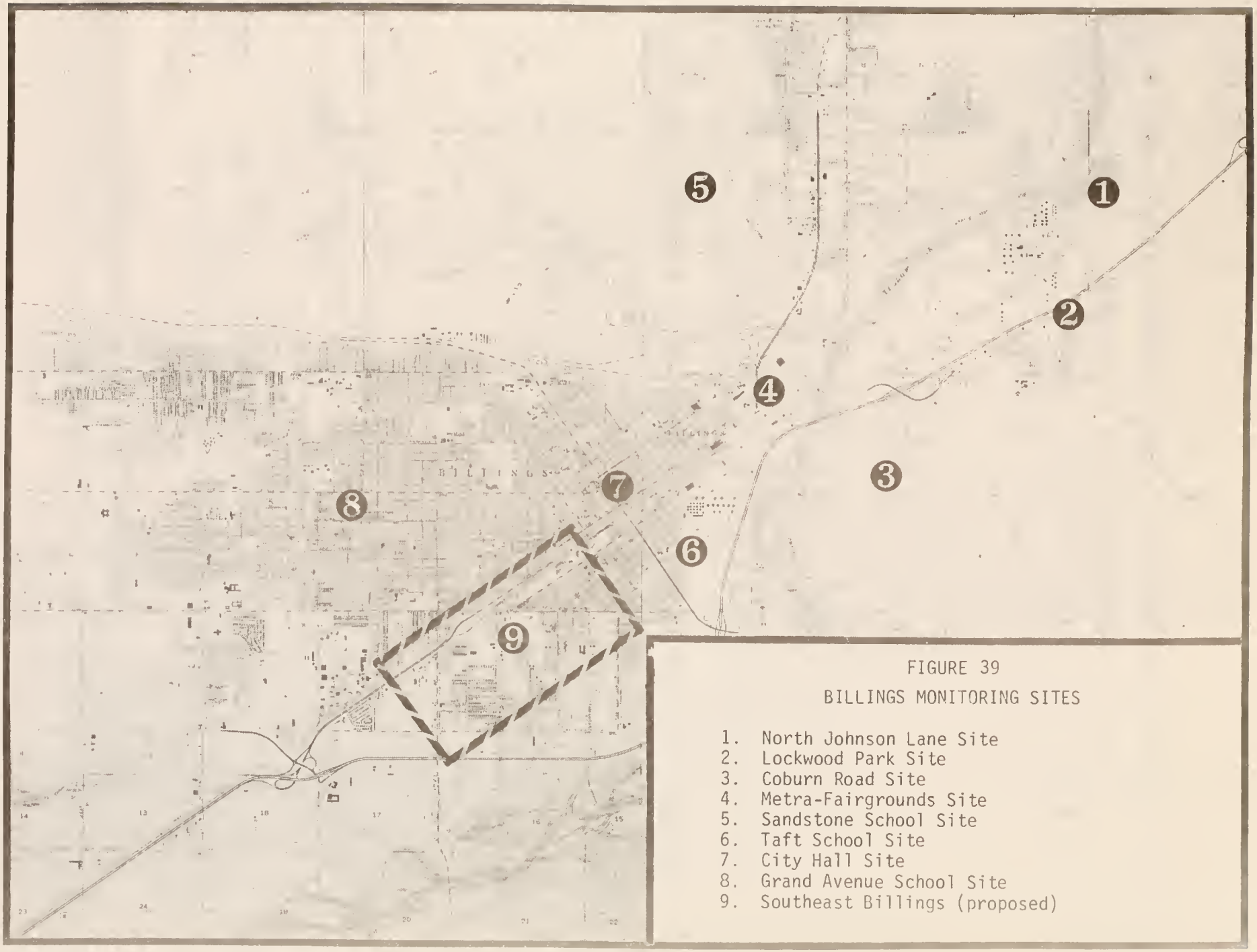


FIGURE 39

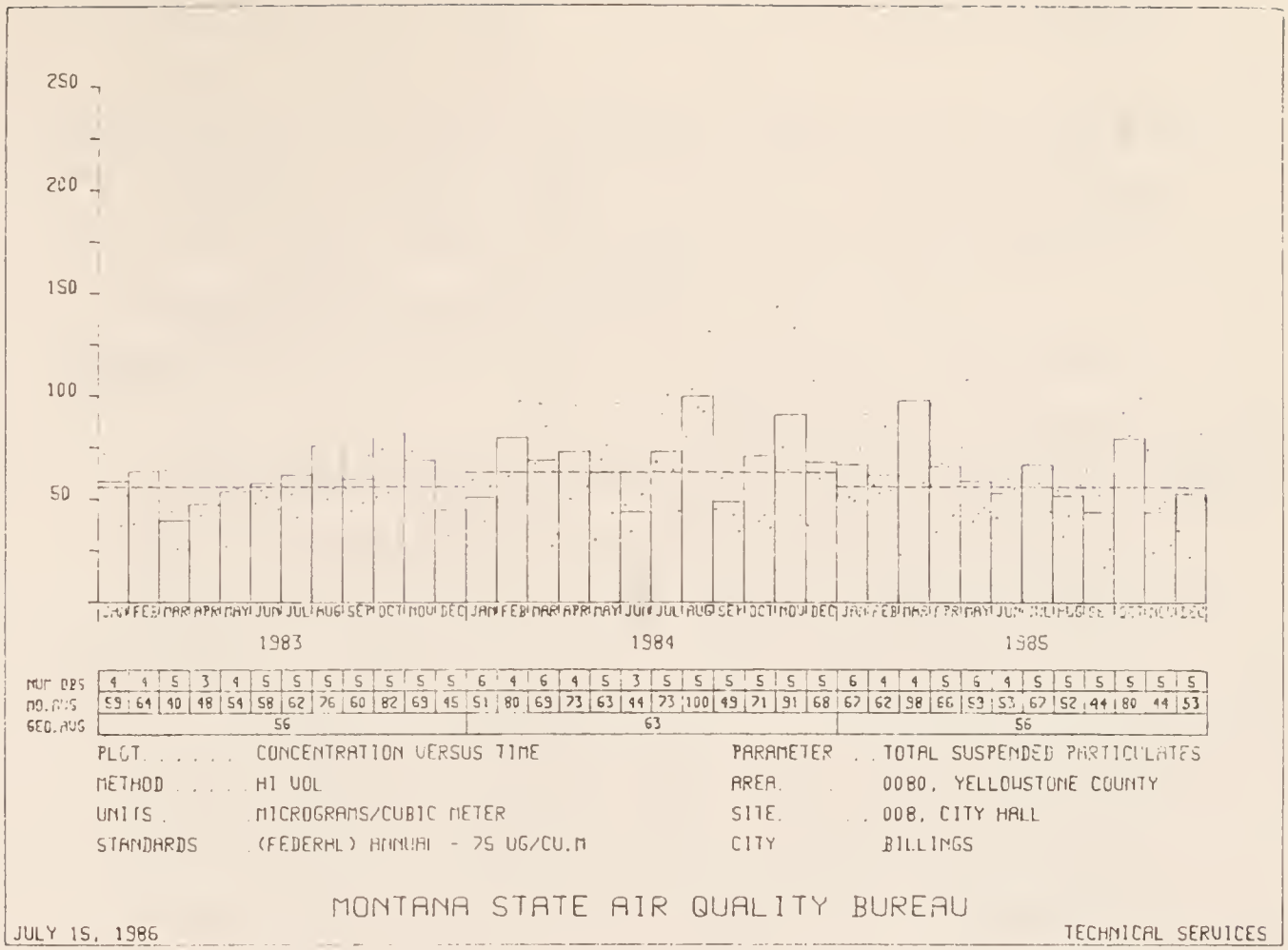
BILLINGS MONITORING SITES

1. North Johnson Lane Site
2. Lockwood Park Site
3. Coburn Road Site
4. Metra-Fairgrounds Site
5. Sandstone School Site
6. Taft School Site
7. City Hall Site
8. Grand Avenue School Site
9. Southeast Billings (proposed)

modeling performed in 1977 by PEDCo-Environmental, Inc., as part of the SIP revision showed that road dust from paved roads was the major contributor to TSP at the City Hall site. A factor analysis described in the 1981 Network Review also identified road dust as the major source influencing the site.

7. The TSP geometric mean at the City Hall site decreased 11 percent during 1985 to 56 ug/m^3. TSP levels at the City Hall site met all state and federal ambient standards. Figure 40 graphically displays the last three years of TSP data from the City Hall site.
8. Yellowstone County personnel will operate collocated TSP samplers at the City Hall site indefinitely. The site is essential for tracking the effectiveness of the nonattainment control strategies.
9. The Taft School site was a collocated NAMS site located in an older residential area and near a major industrial district comprised of the Conoco Refinery, the Western Sugar Company, and the Montana Power Company, Corette Plant. In recent years, a trend developed toward demolishing the older homes in the area and building commercial buildings.
10. During 1985, the Taft School site recorded the highest geometric mean and twenty-four hour readings in Billings. The geometric mean was 63 ug/m^3, down 9 percent from 1984. The TSP data at the Taft School was in compliance with the federal primary standards but violated the state annual and twenty-four hour standards and the federal secondary standards.
11. The department turned over the operation of the Taft School site to the County in July, 1985. The department quit monitoring sulfur dioxide at

FIGURE 40


250
200
150
100
50
1983
1984
1985
NUM OBS 4 4 5 3 4 5 5 5 5 5 5 6 4 6 4 5 3 5 5 5 5 5 5 6 4 4 5 6 4 5 5 5 5 5 5
MO.AVG 59 64 40 48 54 58 62 76 60 82 69 45 51 80 69 73 63 44 73 100 49 71 91 68 67 62 58 66 53 53 67 52 44 80 44 53
GEO.AVG 56 63 56
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 008, CITY HALL
CITY . . . . . BILLINGS
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

the Taft School in December, 1983. Since TSP was the only parameter being monitored at the Taft School and the County is responsible for particulate monitoring in Billings, it was appropriate to transfer the responsibility to them. Yellowstone County decided to shut down the Taft School site in November, 1985, and moved the site to the track at the Grand Avenue School. Since the Taft School area is currently undergoing drastic changes from a residential area to a commercial/ industrial area, the County believed that monitoring should be terminated in the area until the conversion is complete. Monitoring

during the conversion would be biased by emissions from construction activities.

12. During 1985, the department operated a TSP sampler at the Lockwood Park site in conjunction with a sulfur dioxide analyzer. The Lockwood Park site is located in the northwest corner of the Lockwood Little League Park. The park is near the center of the Lockwood area and approximately 0.5 mile south-southeast of the Exxon Refinery and the Montana Sulphur and Chemical Company.

13. The department installed the Lockwood Park high volume sampler in July, 1983, but intends to turn the responsibilities for the sampler over to Yellowstone County on January 1, 1987. The geometric means for TSP were 53 ug/m^3 in 1984 and 52 ug/m^3 in 1985. The 1985 data was in compliance with all state and federal ambient standards.

14. Yellowstone County will continue to operate a high volume sampler at the Lockwood Park site because of its location in the heart of the Lockwood area. In addition, the TSP concentrations are moderately high.

15. Yellowstone County operates a high volume sampler at the Sandstone School in the Billings Heights area. This site was installed in December, 1982, on a recommendation by the department. The objective of the site was to monitor TSP in a rapidly expanding area of Billings.

16. The County has gathered two years of data and the TSP levels are very low. The geometric means were 30 ug/m^3 in 1984 and 32 ug/m^3 in 1985. The highest twenty-four hour value was 96 ug/m^3. The data from this site easily met all state and federal ambient standards.

17. In light of the low TSP concentration, Yellowstone County will shut down the Sandstone School site on January 1, 1987.

18. Yellowstone County is also operating a temporary special purpose high volume sampler in the vicinity of a livestock feed lot near Shepard. The site was established in response to fugitive dust complaints and the data will be retained for local use.

Laurel

1. Laurel is a small town of 5500 people located in the Yellowstone Valley twelve miles upstream from Billings. The CENEX oil refinery is located on the south edge of town. Laurel seems to enjoy slightly better dispersion than Billings, probably because the Yellowstone Valley is wider at this location.

2. Figure 41 is a map showing the location of the Laurel monitoring site. Table 8 summarizes the associated TSP data.

3. The Yellowstone County Air Pollution Control Agency operates a high volume sampler at the Laurel Junior High School. The TSP concentrations are very low in Laurel, registering a geometric mean of 35 ug/m^3 in 1985.

4. Yellowstone County personnel intend to continue to operate this site since it is the only site in the Laurel area.

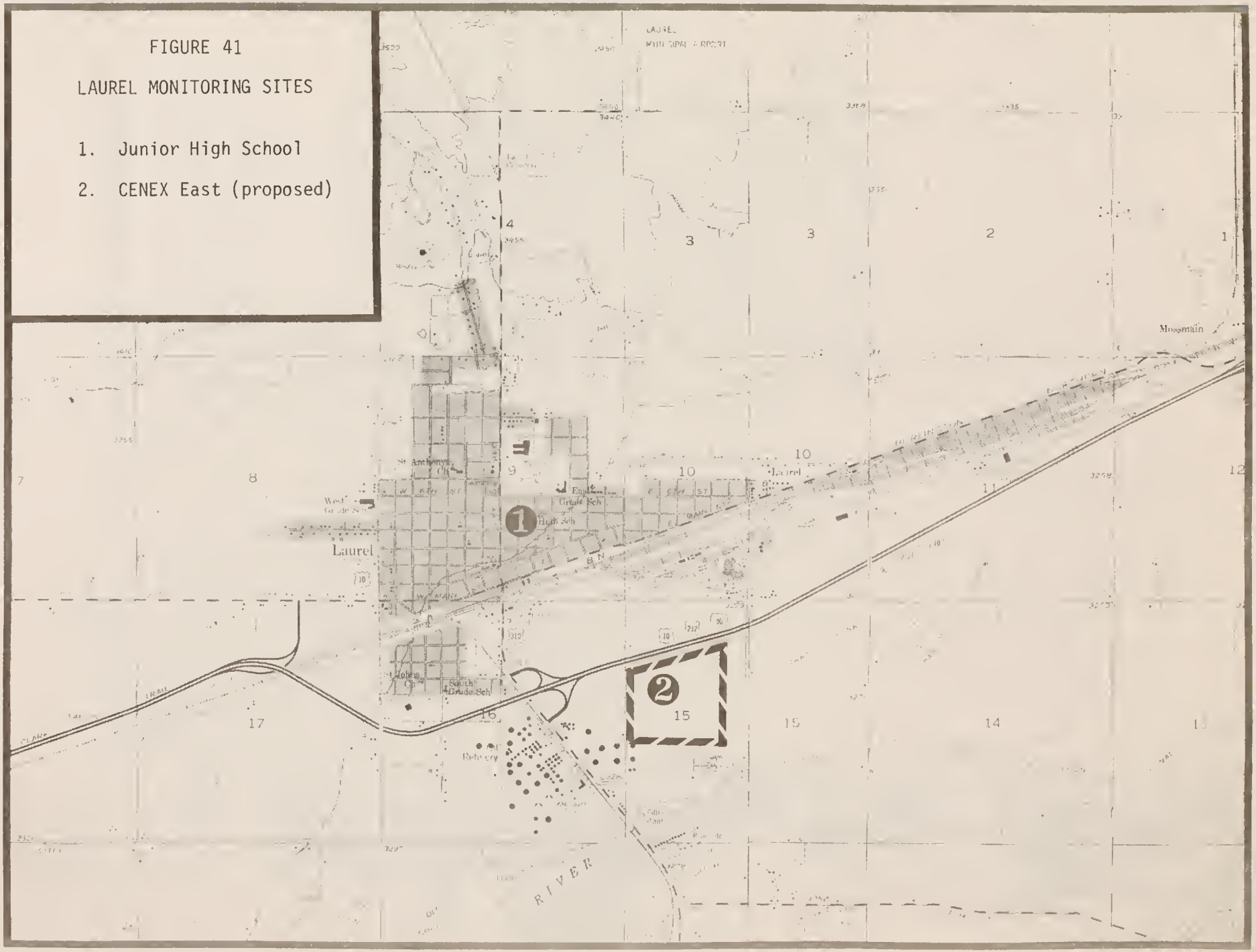
Prospective Sites

1. The department would like to install TSP samplers in Livingston and Roundup. The department staff, however, prioritized the establishment of these sites as very low. Therefore, the availability of funding and personnel time will determine if these sites will be established.

FIGURE 41

LAUREL MONITORING SITES

1. Junior High School
2. CENEX East (proposed)



2. Although dispersion is usually very good in Livingston, the population of the city is almost 7000 people and TSP has never been monitored in the area. Figure 42 shows the proposed location of the site. The department chose this location in order to maximize the impact of emissions from residential wood combustion, the Brand S sawmill and re-entrained road dust.

3. The department proposed a TSP monitor for Roundup for several reasons including: 1) the population of 2100 people; 2) the town lies in a shallow valley along the Musselshell River; 3) several small sawmills and nearby Ponderosa pine forests create a good wood supply; 4) a significant amount of coal is burned in the area; and 5) many of the streets are poorly maintained. The department suggests a monitoring site near the edge of the central business district in order to obtain maximum concentrations which are representative of a large portion of the population. Figure 43 indicates the general area being considered.

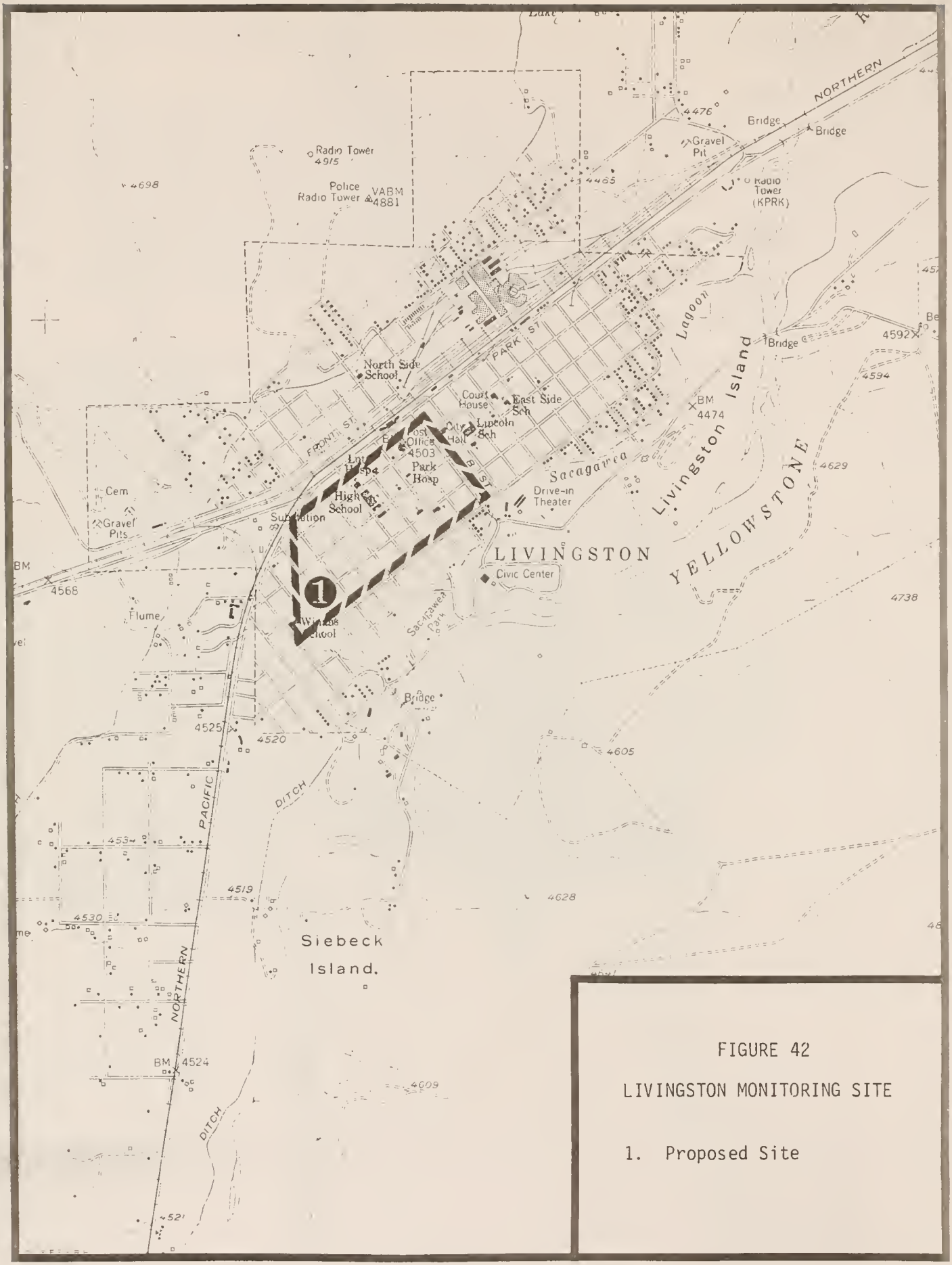


FIGURE 42

LIVINGSTON MONITORING SITE

1. Proposed Site

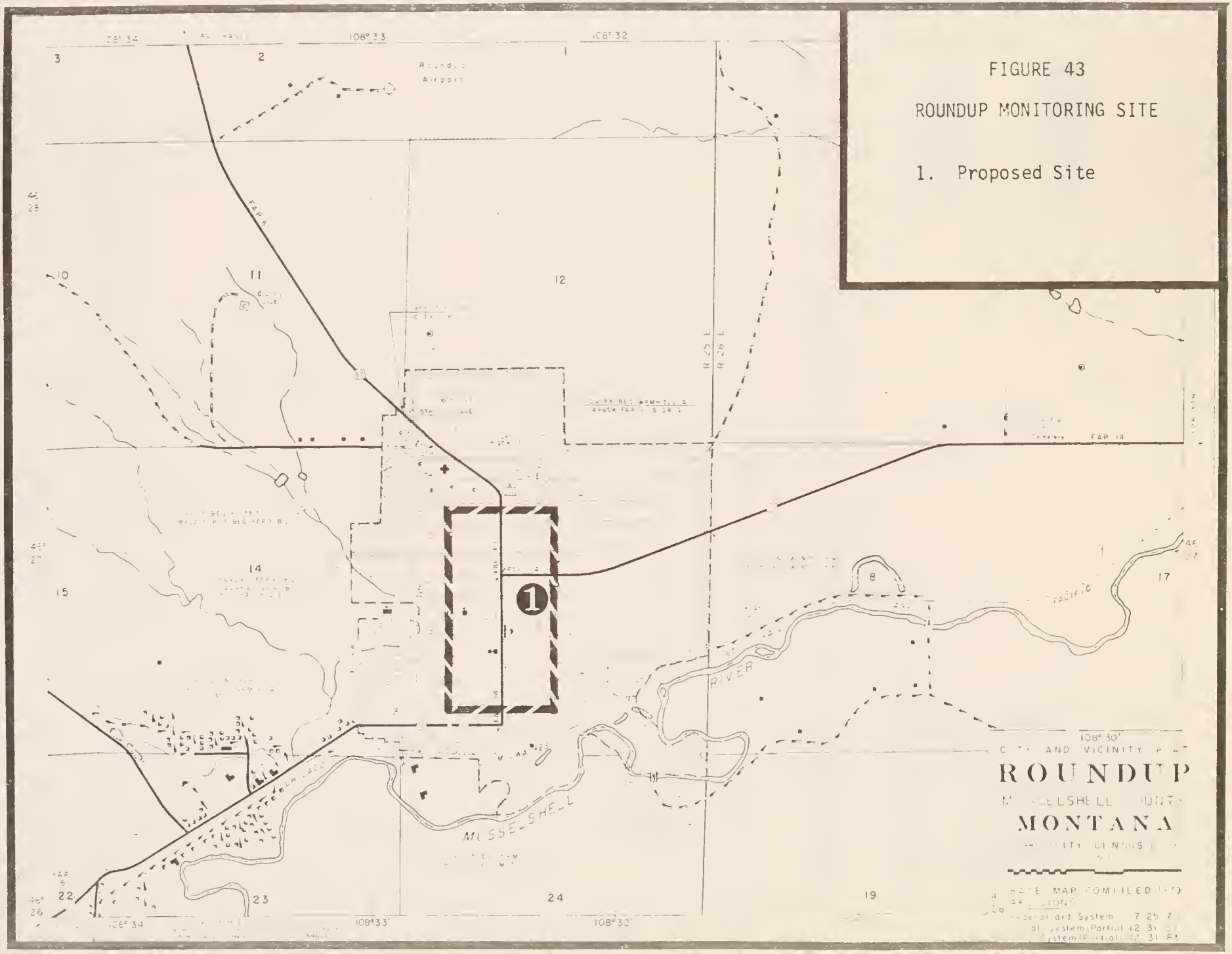
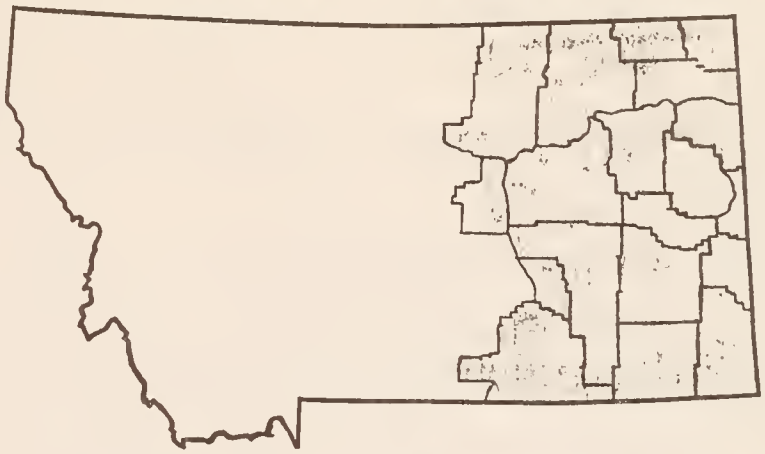


FIGURE 43
ROUNDUP MONITORING SITE
1. Proposed Site
ROUNDUP
MONTANA
MUSSELSHELL RIVER
Roundup Airport
FAP 6
FAP 14
108°33
108°32
108°34
108°30'

EASTERN

MONTANA



The department defines this area of Montana as the entire state east of a north-south line from just west of Malta to just east of Billings. This area actually includes over a third of the state. The area is almost exclusively flat to rolling plains which are occasionally interrupted by small stream and river valleys. The primary land uses are growing small grains and livestock grazing. The flatness of the area provides almost no obstruction to the prevailing west winds and ventilation is usually excellent.

Several years ago, the department started a program to monitor TSP in each of eastern Montana's larger communities. Sites were established in Miles City, Glendive and Sidney. The Miles City site was discontinued in 1983 and the Glendive site was shut down at the end of 1984. The TSP levels were low in both communities.

Scobey

1. Scobey is a small community of 1500 people located in extreme north-eastern Montana. It lies 14 miles south of the Canadian Border and

22 miles south of the Saskatchewan Power Company electrical generating facility. The power plant consists of two 300 megawatt coal-fired generating units. The power plant became fully operational in July, 1983.

2. The Montana Legislature funded the Scobey air monitoring project through June, 1985. They also authorized the use of Legacy Fund money for a scaled-down project during the FY 86-87 biennium. The department shut down all air monitoring in the Scobey area on June 30, 1985, except for a network of sulfation plates. Sulfur dioxide and particulate monitoring are scheduled to restart in September, 1986, for a ten month period. Due to limited funding the department intends to operate only one site, at a location near Scobey.
3. Figure 44 is a map showing the locations of the Scobey monitoring sites and Table 8 summarizes the associated TSP data.
4. The department operated three TSP monitors in the Scobey area: one at the Canadian Border (Border), one 13 miles northeast of Scobey (Hanrahan), and the other just north of town (Richardson). Although the sites were installed to monitor the emissions from the power plant, they are primarily impacted by fugitive dust from agricultural activity.
5. During the first six months of 1985, TSP levels at all three sites were very low. The geometric means ranged from 17 ug/m^3 at the Hanrahan site to 21 ug/m^3 at the Border site. None of the sites violated any state or federal ambient standards.

Sidney

1. Sidney is a city of 5700 people which experienced a strong economic upturn during the late 70's and the early 80's. Oil and gas

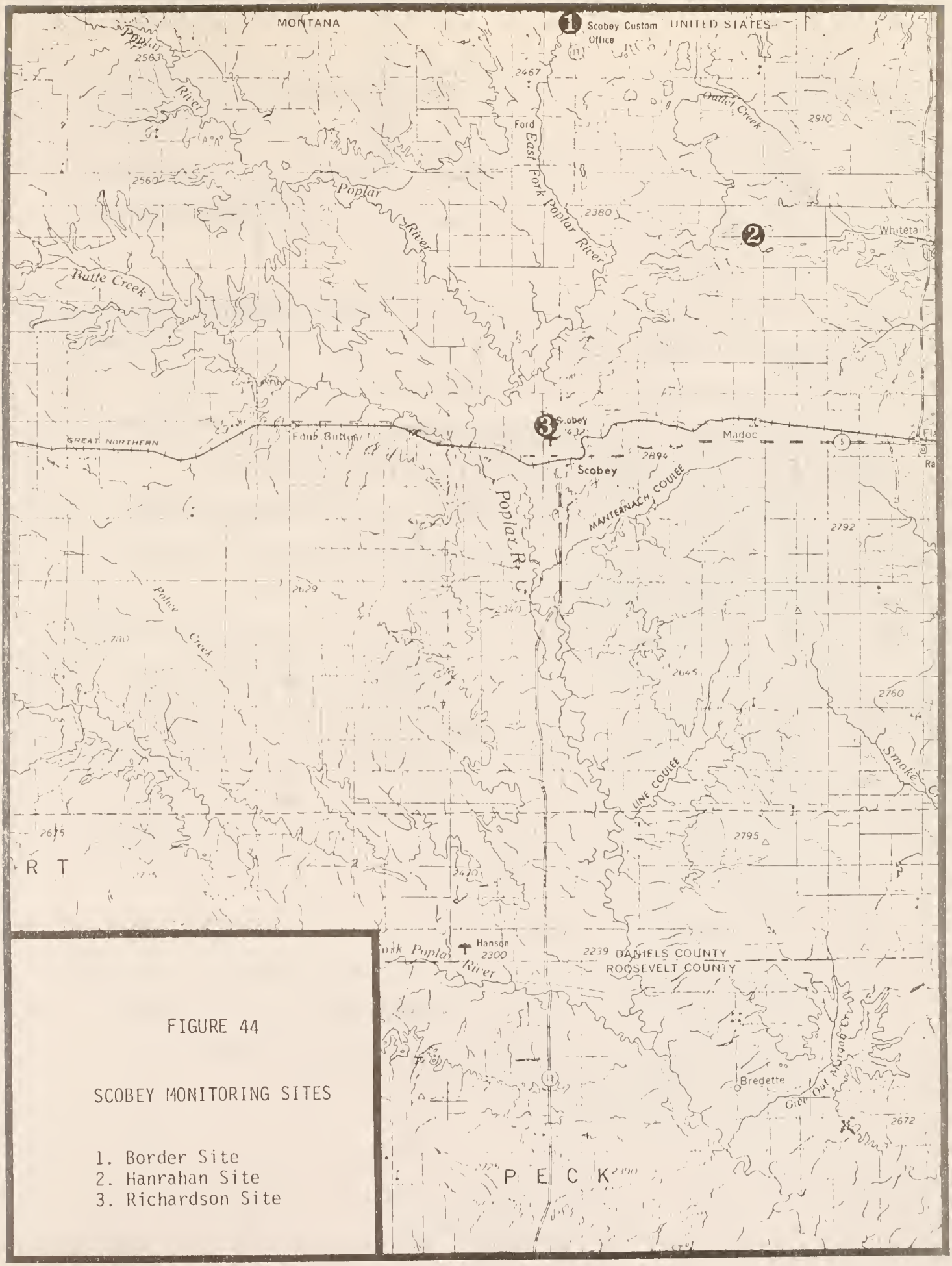


FIGURE 44

SCOBEY MONITORING SITES

1. Border Site
2. Hanrahan Site
3. Richardson Site

exploration and development in the Williston Basin peaked about that time and has since experienced a severe downturn.

2. Figure 45 locates the Sidney monitoring site and Table 8 summarizes the associated TSP data. Figure 46 graphically presents the last three years of data.

3. In light of the oil activity, the department installed a high volume sampler in downtown Sidney during January, 1983. The site has operated for three years and the TSP levels are higher than other eastern Montana sites. The 1985 geometric mean was 50 ug/m^3 and the highest twenty-four hour concentration was 166 ug/m^3. Both of these concentrations are considerably lower than the corresponding 1984 levels. The data from the Sidney site complied with all state and federal ambient standards during 1985.

4. Until April, 1985, the department's chemistry laboratory analyzed the Sidney filters for sulfates. The department thought that sulfates would be indicative of the emissions from the nearby oil and gas activity. The arithmetic mean for sulfates for the first four months of 1985 was 3.9 ug/m^3 or about 9 percent of the TSP. The highest twenty-four hour sulfate concentration was 5.0 ug/m^3. The department considers these values near normal.

5. The department will operate this site at least another year. The department ceased analyzing filters for nitrates in January, 1985 and for sulfates in April, 1986. If TSP concentrations return to their 1983 and 1984 levels, the department will continue to sample and investigate the possible sources.

FIGURE 45

SIDNEY MONITORING SITES

1. City Hall Site

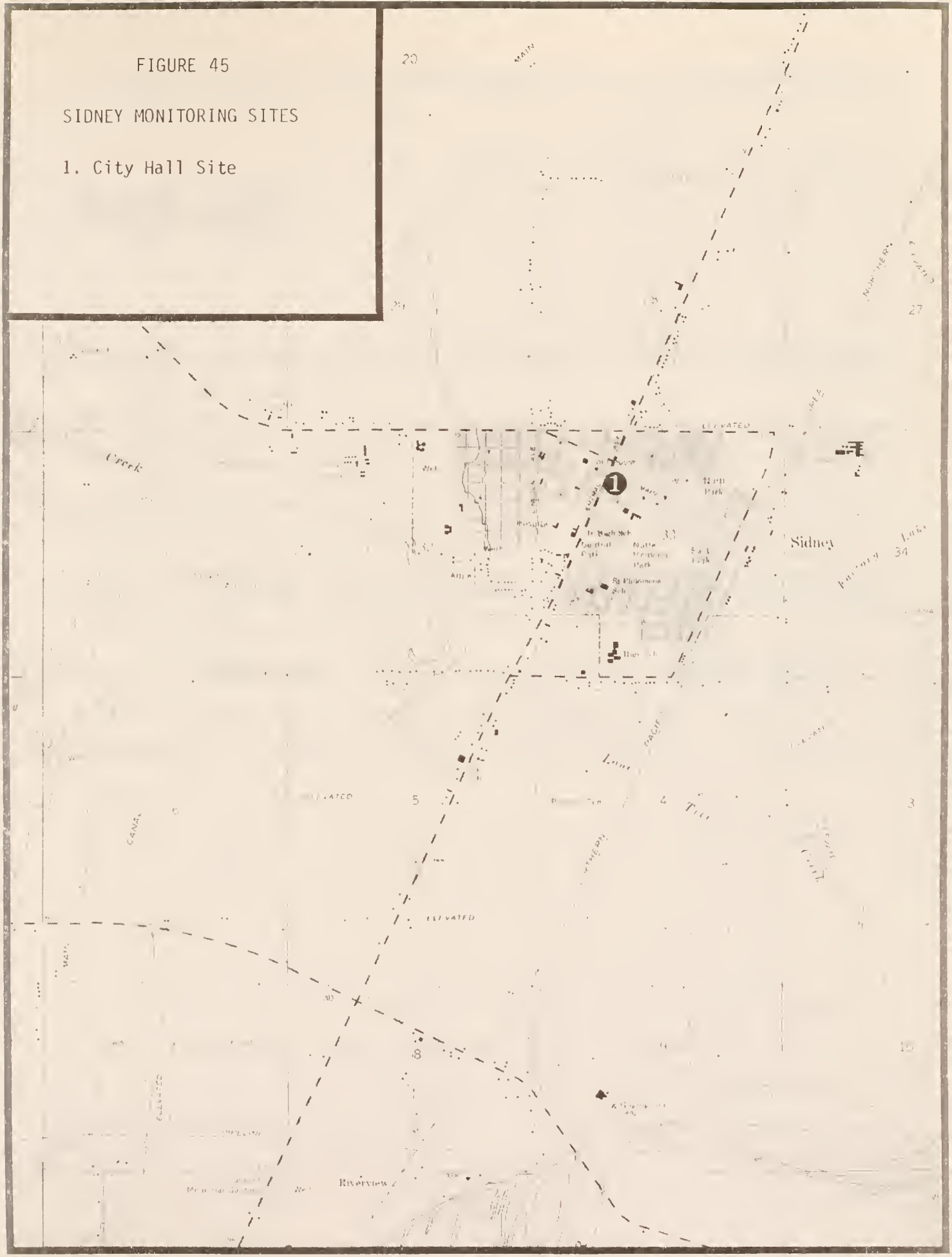
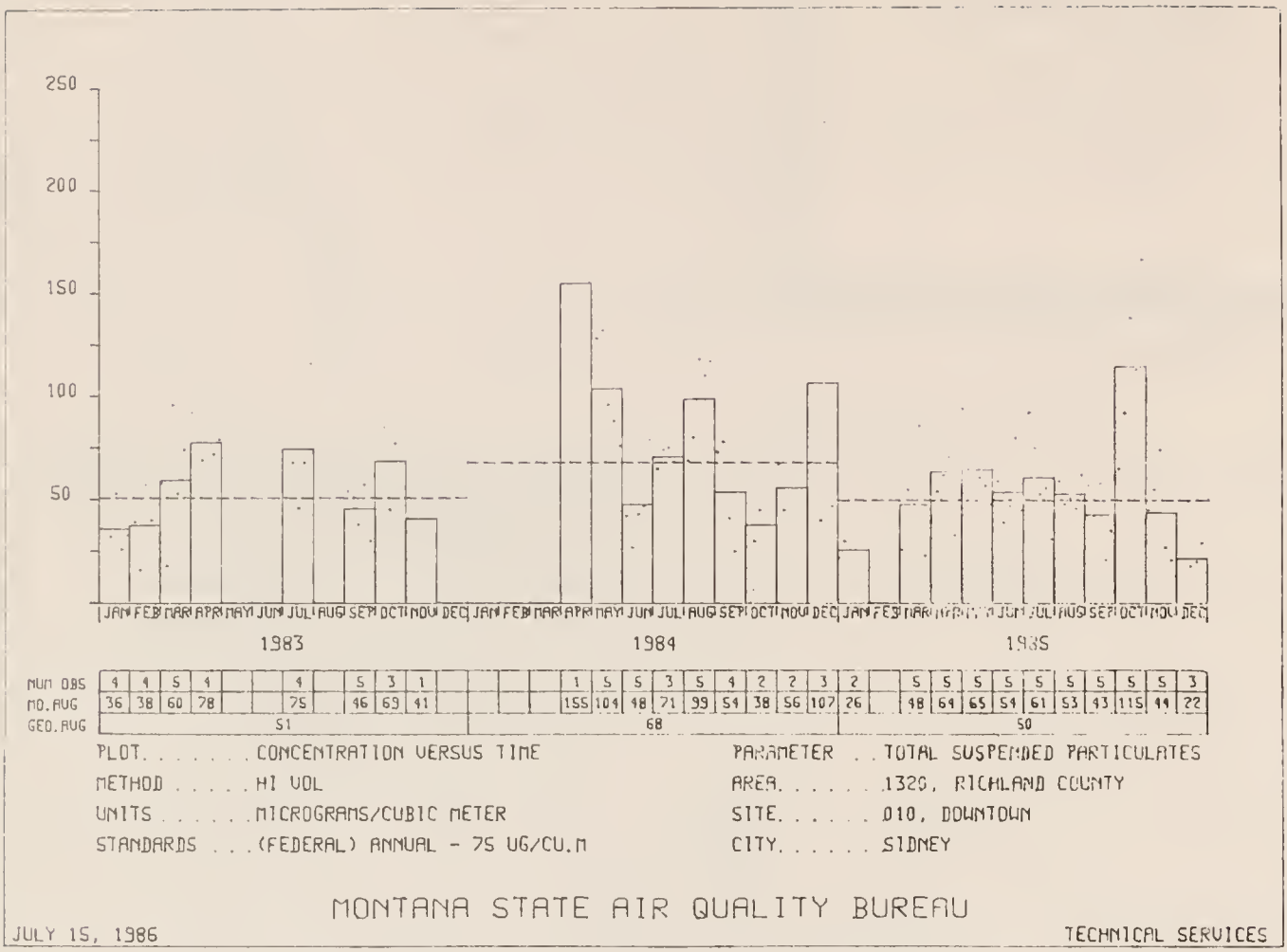


FIGURE 46


250
200
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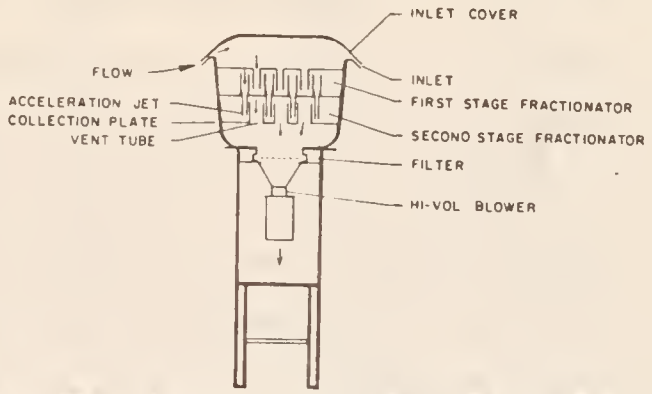
50
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1983
1984
1985
NUM OBS 4 4 5 4 4 5 3 1 1 5 5 3 5 4 2 2 3 2 5 5 5 5 5 5 5 5 5 3
MO.AUG 36 38 60 78 75 46 69 41 155 104 48 71 99 54 38 56 107 26 48 64 65 54 61 53 43 115 44 22
GEO.AUG 51 68 50
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) ANNUAL - 75 UG/CU.M
PARAMETER . . TOTAL SUSPENDED PARTICULATES
AREA. . . . . 1320, RICHLAND COUNTY
SITE. . . . . 010, DOWNTOWN
CITY. . . . . SIDNEY
MONTANA STATE AIR QUALITY BUREAU
JULY 15, 1986
TECHNICAL SERVICES

PM-10



The EPA continuously reviews new research to determine if existing ambient standards are appropriate. In the case of particulates, EPA has determined that a new standard is warranted. The proposed standard is based on particulate matter less than 10 microns in diameter. These smaller particles can penetrate deep into the lungs and pose a much greater health risk than the 30-40 micron particles which are included in TSP.

On March 20, 1984, the EPA published the proposed standard in the Federal Register. Final action on the proposal has been postponed three times to allow for additional comments. It is doubtful that final action will take place until mid-1987.

On May 7, 1984, and August 29, 1984, the department received memoranda via the EPA Region VIII Office from Richard Rhoads, Director of the Monitoring and Data Analysis Division at EPA in Research Triangle Park. These memoranda outlined the method by which EPA PM-10 monitors were to be distributed to the states. Montana received nineteen PM-10 samplers to be distributed to five high priority sites and two moderate priority sites.

EPA determined the priority of the Montana sites using 1980 through 1982 total suspended particulate data, a national frequency distribution for

the ratios of inhalable particulate to total suspended particulate, and a methodology and computer program developed by EPA to establish the probability of a site exceeding the proposed PM-10 standards.

The department, in a parallel action, utilized the EPA methodology and computer program to develop its own site priority list. A review of the EPA and Montana results indicated some differences. The differences were caused by the following:

1. EPA used only the national frequency distribution for inhalable to total suspended particulate ratios while Montana used site specific frequency distributions.

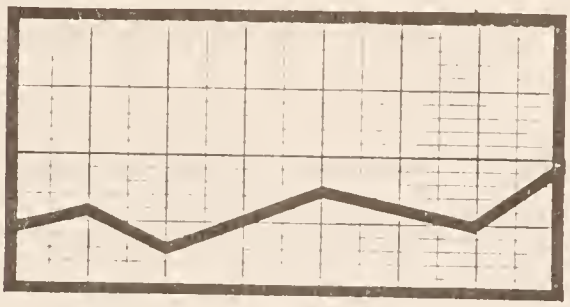
2. EPA used only 1980-1982 TSP data while Montana used 1981-1983 data for the national frequency distribution run and the most current three years of data between 1978 and 1983 for the site specific frequency distribution runs.

As a result of the above-mentioned analyses and the department's knowledge of the emission sources affecting each site, the department made a commitment in the 1985 Network Review to establish PM-10 monitoring at fifteen locations. Table 14 lists the sites where the department planned to perform PM-10 monitoring and the status of each site as of July 1, 1986.

TABLE 14
PRESENT PM-10 NETWORK

Area	Site	Sampling Frequency	Number of Samplers	Status of Site on June 1, 1986
Libby	Lincoln Co. Courthouse	every sixth day	2 (1 coloc)	Operational collocated site
Missoula	Rose Park	daily	2	Operational
	Boyd Park	daily	2	Operational
	Meadow Hill School	every third day	2	No plans to initiate PM-10 monitoring at this site; however, PM-15 monitoring is in progress.
Bozeman	East Main City Bldg.	every sixth day	1	Operational
Butte	Greeley School	every sixth day	1	Operational
Helena	Cogswell Building	every sixth day	2 (1 coloc)	Operational
Helena	Phillips Lane	every sixth day	1	Operational
Columbia Falls	Junior High School	every sixth day	1	Operational
Kalispell	Universal Athletics	every sixth day	1	Operational
Billings	City Hall	every sixth day	1	Alternate site at Grand Ave. is operational.
Thompson Falls	Sanders Co. Courthouse	every sixth day	1	Operational
Western Montana Bkgd.	Ovando-Smith	every sixth day	1	Operational
E.Helena	Firehall	every sixth day	1	No action taken; looking for new location in a different community
Hamilton	Ravalli Co. Courthouse	every sixth day	1	Operational
Great Falls	Downtown	every sixth day	1	Operational
Polson	Saddle Shop	every sixth day	1	Operational
Spare samplers not obligated			2	Site selection in progress

SEASONAL PM-10 TRENDS



Particulate levels in Montana vary drastically by season. In the 1985 Network Review, the department reviewed the seasonal variations in TSP concentrations in great detail. The major findings of the 1985 review were:

1. Particulate concentrations increase during July and August throughout the entire state, probably due to fugitive dust.
2. Western Montana sites recorded their highest particulate concentrations during the late fall and winter, probably because of residential wood burning.
3. Western Montana towns had higher TSP concentrations than all other subcategories including Western Montana cities.
4. Western Montana's small towns registered high concentrations, probably because they have inadequate street cleaning equipment, natural gas is unavailable and residents rely on wood heat, and they do not have air pollution control programs.

The department considered performing a similar review for PM-10, but decided that the amount of PM-10 data available was insufficient. Instead the department condensed the analysis by focusing on Western Montana's cities and towns and divided the year into two halves: winter and summer. This approach provided adequate data for a cursory review of seasonal PM-10 patterns.

The department selected monitoring sites which recorded both PM-10 and TSP data during 1985. The data was paired at each monitoring site and then the date from various sites was combined into two large data sets: one for the cities over 8000 population and one for towns under 8000 population.

The department performed a linear regression analysis on each of these data sets to compare the PM-10 and corresponding TSP data. The results of the analyses are presented in Table 15.

TABLE 15

SEASONAL COMPARISON OF PM-10 AND TSP
FOR WESTERN MONTANA CITIES AND SMALL TOWNS(1)

Community Size(2)	Season(3)	No. of Samples	PM-10(4) Mean	TSP(4) Mean	% of TSP	Correlation Coefficient(5)
Cities	Winter	79	71.5	93.2	76.7	.929
	Summer	28	29.1	48.7	59.7	.828
Towns	Winter	22	55.3	82.4	67.1	.912
	Summer	33	50.6	92.1	54.9	.979

(1) This table contains only paired data.
(2) A population of greater than 8000 people was used to distinguish cities from towns.
(3) Winter equals January, February, March, October, November and December. Summer equals April through September.
(4) All concentrations are in ug/m^3.
(5) The correlation coefficient displayed represents the correlation between PM-10 and TSP.

The results indicate that, regardless of the size of the community, PM-10 constitutes a larger percentage of the TSP during the winter than during summer. This finding is consistent with the fact that during the winter the primary emission sources are fine particulate sources such as residential wood burning, wood product industries, and automobile tailpipe emissions. The larger particulates associated with fugitive dust sources such as re-entrained road dust are less important during the winter due to snow cover. Since most of the particulate in the atmosphere of Western Montana during the winter is fine particulate, the PM-10 and TSP concentrations more closely approximate each other.

The Western Montana results also show that PM-10 makes up a larger portion of the TSP in the cities than the towns. The department believes that more paved streets, better street maintenance and better street cleaning are controlling re-entrained road dust in the larger communities.

The percentage of TSP which is less than ten microns in diameter appears to be much higher in Western Montana than in the nation as a whole. The national average is approximately 44 percent while in Western Montana the average is 60 percent for the small towns and 72 percent for the larger cities. This information underscores the significant impact that the proposed PM-10 standard will have on Montana. The department believes that additional PM-10 monitoring in Western Montana will result in violations of the proposed standard in most communities with a population of over 1000 people.

PM-10 SITE BY SITE EVALUATION

In the remainder of the PM-10 section, the department focuses on each individual monitoring site. The department reviews the monitoring data, discusses the operational status of each site, and identifies any proposed monitoring changes.

Table 16 summarizes the 1985 PM-10 data from all the Montana monitoring sites. Since the department established most of the sites during the summer of 1985, there is generally less than six months of data at each site. In addition, the samplers which were provided by EPA were generally in poor condition and required numerous repairs, especially to the flow controllers. Due to equipment failures, data collection efficiency during the first six months of operation was also poor.

At each monitoring site where both PM-10 and TSP were monitored, the department decided to review the relationship between the two parameters. The department paired the data and calculated the means for both parameters and performed a linear regression analysis. The results are presented in Table 17 and described in detail in the narrative for each site.

TABLE 16

SUMMARY OF PM-10 CONCENTRATIONS AT MONTANA SAMPLING LOCATIONS*

Location	Site	No. Samples	Arith. Mean	1st Max. 24-hour	2nd Max. 24-hour
Libby	Lincoln Co. Courthouse	26	59	114	114
Thompson Falls	Sanders Co. Courthouse	26	49	89	85
Columbia Falls	Junior High School	29	39	77	76
Kalispell	Universal Athletics	20	48	77	68
Missoula	Rose Park	13	94	257	135
Missoula	Boyd Park	5	66	90	87
Ovando	Smith Ranch	27	26	69	63
Helena	Cogswell Bldg.	36	32	80	64
Helena	Phillips Lane	31	35	138	65
Butte	Greeley School	28	87	302	235
Bozeman	East Main City Building	6	42	64	52
Great Falls	Downtown	10	14	31	18

*All concentrations are in ug/m^3.

TABLE 17

COMPARISONS BETWEEN 1985 PM-10 AND TSP DATA AT MONTANA MONITORING SITES(1)

City	Site	No. of Samples	PM-10(2) Mean	TSP(2) Mean	% of TSP	Correlation(3) Coefficient
Libby	Lincoln Co. Cthse.	26	58.7	95.7	61.3	.886
Thompson Falls	Sanders Co. Cthse.	23	50.2	86.4	58.1	.945
Columbia Falls	Junior High School	6	34.5	62.8	54.9	.992
Kalispell	Universal Athletics	17	47.6	76.1	62.5	.593
Missoula	Rose Park	13	94.0	110.8	84.8	.948
Missoula	Boyd Park	3	56.0	69.3	80.8	.592
Ovando	Terry Smith Ranch	24	26.6	30.5	87.2	.884
Helena	Cogswell Building	28	32.4	50.6	64.0	.835
Butte	Greeley School	13	94.1	106.9	88.0	.988
Bozeman	East Main City Bldg.	6	42.3	77.3	54.7	.951
Great Falls	Downtown	10	13.9	46.7	29.8	.826

(1) This table contains only paired data.
(2) All concentrations are in ug/m^3.
(3) The correlation coefficients displayed represent the correlation between PM-10 and TSP.

Libby

1. The department installed collocated PM-10 samplers at the Lincoln County Courthouse during May, 1985. The arithmetic mean for the last eight months of 1985 was 59 ug/m^3. This concentration is within the range (50-65 ug/m^3) proposed by EPA for the annual PM-10 standard. The maximum twenty-four hour concentration was 114 ug/m^3. This value is well below the proposed short-term standard of 150-250 ug/m^3.
2. The department compared the PM-10 concentrations with TSP levels and found that 61.3 percent of the TSP is less than ten microns in diameter. This percentage is considerably above the national average of 44 percent. In addition, the PM-10 data correlated quite well with the TSP data. In light of these facts, the department believes that the major emission sources contributing to TSP are also the major PM-10 sources.
3. The 1984 and 1985 Libby study indicated that the primary emission sources affecting the coarse size class (2.5 to 15 micron) are re-entrained road dust and the Champion hogged fuel boilers. The study also identified the primary sources of fine particulate (less than 2.5 microns) to be residential wood combustion and re-entrained road dust. Since residential wood combustion and the Champion boilers emit particulates which are largely under 10 microns in diameter and because recent research in the desert southwest indicates that the percentage of PM-10 in fugitive dust (approximately 50 percent of the TSP) is much greater than previously believed, the department is convinced that Libby will violate the proposed PM-10 standard. This conclusion is reinforced by the extremely high TSP levels recorded in Libby.

4. The department intends to continue to operate collocated PM-10 monitors at the Lincoln County Courthouse.

Thompson Falls

1. The department initiated PM-10 monitoring at the Sanders County Courthouse in May, 1985. The arithmetic mean for the last eight months of 1985 was 49 ug/m^3. This concentration is slightly less than the proposed PM-10 standard. The highest twenty-four hour concentration was well below the proposed standard at 89 ug/m^3.
2. The department compared PM-10 and TSP data for this site and found that 58.1 percent of the TSP is less than ten microns in diameter. The results of the linear regression analysis indicate that PM-10 levels correlate extremely well with TSP. Apparently, the same emission sources are the major contributors to both PM-10 and TSP. The department believes that the major particulate sources are re-entrained road dust, residential wood combustion, and emissions from the W. I. sawmill tepee burner and boilers.
3. The department intends to operate this PM-10 site indefinitely.

Columbia Falls

1. The department commenced PM-10 sampling at the Columbia Falls Junior High School in May, 1985. Based on eight months of data in 1985, the arithmetic mean was 39 ug/m^3 and the highest twenty-four hour concentration was 77 ug/m^3. Both of these concentrations are well below the proposed PM-10 standards.
2. The department compared PM-10 and TSP concentrations despite the fact that only six pairs of data were available. The results indicated that 54.9 percent of the TSP is less than 10 microns in diameter and that

the two parameters exhibit an excellent correlation. The department believes that the primary sources of particulate emissions in Columbia Falls are the Plum Creek sawmill-plywood-particleboard complex, re-entrained road dust and residential wood burning. Furthermore, these sources are apparently impacting both the PM-10 sampler and the TSP sampler.

3. The department will continue to operate a PM-10 sampler at this location and intends to increase the sampling frequency to every third day. The more intensive schedule will assist in quickly determining the compliance status of the area and developing a sound data base. In light of the high TSP levels recorded at both of the TSP sites in Columbia Falls, the department believes the area will violate the proposed PM-10 standards.

Kalispell

1. The Universal Athletics site was installed by the department during May, 1985. Due to problems with the flow controller, the first valid sample was not collected until the end of July. The arithmetic mean for PM-10 for the last five months of 1985 was 48 ug/m^3. This concentration is slightly below the range of the proposed PM-10 standard. The highest twenty-four hour concentration was 77 ug/m^3 which is well below the proposed standard.

2. The department compared the PM-10 data and TSP data from the Universal Athletics site and determined that the average PM-10 concentration was 62.5 percent of the average TSP concentration. This information appears to indicate that much of the particulate in Kalispell's airshed is less than 10 microns in diameter. On the other hand, the correlation between the two parameters was poor, which seems to indicate that

different emission sources are impacting each parameter. Since both samplers are at the same location, the major emission sources affecting the samplers would need to have drastically different particle size characteristics for one source to almost exclusively affect PM-10 while the other almost exclusively affects TSP. This hypothesis is in direct opposition to the fact that 62.5 percent of the TSP is less than ten microns in size.

3. The department is initiating a special one year chemical mass balance (CMB) study in the city of Kalispell to determine source contributions at the Universal Athletics site and a site on the west side of the city. The CMB analysis will use dichotomous samplers as the primary monitoring tool. Therefore, source contributions will be determined for both the 0-2.5 micron and the 2.5-15 micron size classes.
4. The department intends to continue to operate a PM-10 monitor at the Universal Athletics site for at least two years. Upon completion of the CMB study, the department intends to increase the sampling frequency to every third day. This action should speed up the process of determining the compliance status of the area and developing a sound PM-10 data base.

Missoula

1. The Missoula County Health Department operates daily PM-10 sampling at the Boyd Park and Rose Park sites. Both sites are equipped with two PM-10 monitors running on alternate days. Two of the samplers belong to Missoula County while the other two were provided by EPA.
2. The Missoula County Health Department started daily PM-10 sampling at the Rose Park site in May, 1985. However, a procedural error during

calibration resulted in invalid data until December, 1985. Based on thirteen samples in 1985, the arithmetic mean of 94 ug/m^3 was the highest arithmetic mean recorded in Montana for PM-10. Although this concentration is far in excess of the proposed PM-10 standard, Missoula usually records high particulate levels during the winter. The highest twenty-four hour concentration was 257 ug/m^3, which is also above the proposed standard. The department is convinced that PM-10 levels at Rose Park will exceed the proposed standards.

3. The department performed a linear regression analysis on the PM-10 and TSP data from Rose Park and found that the two parameters correlated very well. The arithmetic mean for the PM-10 data was 84.8 percent of the mean for TSP. This percentage is very high indicating that almost all of the TSP is less than ten microns in diameter. The department should also point out that the national average is only 44 percent. Although the high percentage is surprising, it is explainable. In the winter, residential wood combustion is the primary source of particulates in Missoula and wood smoke is almost exclusively comprised of fine particulates.

4. Missoula County intends to continue daily sampling at Rose Park indefinitely. Daily sampling will provide information on the compliance status of the area within a year. In addition, daily sampling at Rose Park in conjunction with Boyd Park will provide Missoula with the most comprehensive PM-10 data base in Montana.

5. The Missoula County Health Department also operates daily PM-10 sampling at the Boyd Park site. PM-10 monitoring also started at this site in early 1985, but an error in the calibration procedure

prohibited collection of valid data until December, 1985. During 1985, an every third day sampling schedule was maintained. The sampling schedule was changed to daily sampling in February, 1986, when an additional sampler was installed. The arithmetic mean for the five samples collected during December, 1985, was 66 ug/m^3 and the highest twenty-four hour value was 90 ug/m^3. Although the mean is quite high it is based on only five samples and those samples were collected in the winter when particulate levels are normally high.

6. The department compared PM-10 and TSP data at Boyd Park even though only three pairs of data were available. Although it is impossible to draw any conclusion from such a limited data set, the results are included in Table 17.

7. The Missoula County Health Department plans to operate daily PM-10 sampling at Boyd Park indefinitely. Since Missoula County personnel eventually plan to make the Boyd Park site the focus of their emergency episode monitoring, PM-10 sampling at this site will become even more important in the future.

Hamilton

1. The department installed a PM-10 monitor at the Ravalli County Courthouse in May, 1986. The 1985 Network Review scheduled this site to be operational by October, 1985, but equipment problems caused a delay.

2. The department considers Hamilton to be one of the Western Montana communities where compliance with the proposed PM-10 standard will be marginal. Therefore, the department intends to operate the site for at least two years.

Ovando

1. The department began sampling for PM-10 at the Terry Smith Ranch in June, 1985. The Terry Smith ranch is located in the sparsely populated upper Blackfoot Valley and serves as a Western Montana background site. During the last seven months of 1985, the arithmetic mean for PM-10 was 26 ug/m^3. This concentration is low, but somewhat higher than anticipated. However, the highest TSP levels for this site have historically occurred during June, July and August, and these three months comprised over 40 percent of the sampling period. The highest twenty-four hour concentration was 69 ug/m^3, which is far below the proposed PM-10 standard.
2. The department analyzed the relationship between PM-10 and TSP and discovered that the PM-10 levels averaged 87.2 percent of the TSP concentrations. This represents an extremely high percentage, considering that the national average is 44 percent. However, the fact that most of the particulate is less than ten microns in diameter indicates that the site is an excellent background site which is relatively free of local fugitive dust sources. The site, in all likelihood, is monitoring regional air pollution which has been transported a considerable distance or at least has remained suspended for an extended period of time. The department believes that the very good correlation between PM-10 and TSP also reinforces this conclusion.
3. The department will continue to operate a PM-10 sampler at the Ovando site for at least two years. After two years, an excellent PM-10 data base will have been developed and the site will be re-evaluated.

Helena

1. The department operates two PM-10 monitoring sites in the vicinity of Helena. The primary site is on the top of the Cogswell Building in the Capitol Complex and the other site is on Phillips Lane out in the Helena valley.
2. The department installed collocated PM-10 monitors at the Cogswell Building during May, 1985. The Cogswell Building was selected for collocated sampling because of moderate TSP levels and to provide the Helena staff with good hands-on experience in regard to PM-10 monitoring. The arithmetic mean for PM-10 for the first eight months of operation was 32 ug/m^3 and the highest twenty-four hour concentration was 80 ug/m^3. Both concentrations are well below the proposed PM-10 standards.
3. The department compared PM-10 and TSP data from the Cogswell Building site and found that 64.0 percent of the TSP was less than ten microns in diameter. The results of the linear regression analysis indicated a very good correlation between PM-10 and TSP concentrations. Apparently, the same emission sources are affecting both parameters and the sources are largely fine particulate emitters.
4. The department will continue to operate a PM-10 monitor at the Cogswell Building, but intends to move the collocated sampler to Butte. The department considers Butte to be a better location for collocated sampling because of higher PM-10 concentrations.
5. The department also operates a PM-10 sampler at Phillips Lane in the Helena valley. The site is located approximately 1.5 miles north of the Helena city limits in a small residential area. The site is also

very close to Ten Mile Creek which is the lowest point in the valley. Several staff members suspect that during temperature inversions, downslope drift from Helena causes high concentrations of fine particulate to accumulate in this area. The most important emission source is likely residential wood combustion.

6. The department installed the Phillips Lane PM-10 monitor during June, 1985. During the last seven months of 1985, the arithmetic mean for PM-10 was quite low at 35 ug/m^3. This value, however, was slightly higher than levels at the Cogswell Building over the same period of time. The highest twenty-four hour concentration was 138 ug/m^3 which is also higher than the comparable reading at the Cogswell Building.
7. The department intends to run the Phillips Lane PM-10 monitor for at least two years to develop a sound data base for the area.

East Helena

1. In the 1985 Network Review, the department proposed installing a PM-10 monitor at the Firehall site in East Helena. The department proposed this site because (1) it exhibited a moderate probability of exceeding the proposed standards, (2) it consistently records the highest lead values in the area, and (3) it usually records the second highest TSP levels in East Helena.
2. The department did not install a PM-10 monitor in East Helena as planned because the Firehall site was not capable of handling another sampler without violating siting criteria. In light of the siting problems and the fact that the East Helena Lead Study clearly identified the particle size characteristics of ambient lead levels, the department has decided not to locate a PM-10 sampler in East Helena.

Butte

1. The department started PM-10 monitoring at the Greeley School in Butte during June, 1985. However, equipment problems resulted in no data being collected during July and August. The arithmetic average for the twenty-eight samples collected in 1985 was 87 ug/m^3. This was the second highest arithmetic mean for PM-10 recorded in Montana during 1985 and was far in excess of the proposed PM-10 standard. The Greeley School site also recorded the first and third highest twenty-four hour PM-10 concentrations in Montana with readings of 302 ug/m^3 and 235 ug/m^3. Based on less than seven months of data, Butte already exceeds the proposed PM-10 standards.
2. The department reviewed the relationship between concurrent PM-10 and TSP data gathered at the Greeley School site and found that the arithmetic mean for PM-10 was 88.0 percent of the arithmetic mean for TSP. This is the highest percentage found in Montana during 1985. The PM-10 and TSP data also exhibited an excellent correlation coefficient, in fact, the best in the state. This data appears to indicate that sources of fine particulates are the primary contributors to PM-10 and TSP in Butte.
3. In 1981, essentially all mining and concentrating ceased in Butte. TSP levels in Butte declined approximately 40 percent from 1981 to 1984 and Butte actually was meeting the federal primary standards. However, in 1985, the TSP levels once again surged upward despite the lack of mining activity. The department concluded that a new source of particulates was responsible for the increase. Figure 31 shows a monthly plot of TSP levels for the four years prior to 1981 and the four years

after 1981. Obviously a new source of particulates is impacting wintertime air quality. The department believes that residential wood combustion is the most likely source. The fact that wood smoke is primarily composed of fine particulate adds credence to the observations discussed above that 88.0 percent of the TSP is less than ten microns in diameter.

4. The department intends to install a second PM-10 monitor at the Greeley School during the late summer of 1986. The second sampler will be used to establish precision data for PM-10 monitoring. The department considers the Greeley School site an important part of the Montana PM-10 network and plans to operate the site indefinitely.

Bozeman

1. The department started PM-10 monitoring at the East Main City Building in Bozeman during July, 1985. Due to problems with the flow controller, no valid data was collected during August, September and December of 1985. As a result, only six valid samples were collected during 1985. Based on those six samples, the arithmetic mean was 42 ug/m^3 and the highest twenty-four hour concentration was 64 ug/m^3. Both of these values are well below the proposed PM-10 standards.
2. The department performed a linear regression analysis on the Bozeman data despite the fact that only six pairs of data were available. Due to the limited amount of data available it is impossible to draw any conclusions from the analysis.
3. The department intends to operate this site for at least two more years.

Great Falls

1. The Cascade County Health Department initiated PM-10 monitoring at the Downtown site in Great Falls during October, 1985. The arithmetic mean for PM-10 for the last two months of 1985 was very low at 14 ug/m^3. The highest twenty-four hour concentration was also very low at 31 ug/m^3.
2. The department compared the PM-10 data with the TSP data and found that the arithmetic mean for PM-10 was 29.8 percent of the mean for TSP. Although only ten pairs of data were used in the analysis, this is the only site in Montana where the PM-10 mean was less than 50 percent of the TSP mean. Apparently most of the particulate in Great Falls' atmosphere is larger than ten microns in diameter. The results of the linear regression analysis indicated that PM-10 and TSP levels correlate very well. The department concludes that both parameters are being affected by the same emission sources, but that the emissions are mainly in the larger size ranges.
3. The department and Cascade County do not anticipate that PM-10 levels in Great Falls will even approach the proposed standards. However, Cascade County will continue to monitor PM-10 at the Downtown site for at least two years to establish a good data base.

Billings

1. The Yellowstone County Air Pollution Control Agency started PM-10 monitoring at the new Grand Avenue site during June, 1986. Yellowstone County originally planned to install this sampler at the City Hall site. However, the Grand Avenue site was chosen instead because the site easily meets all siting criteria and TSP concentrations are

approximately equal to the levels recorded at the City Hall. The City Hall site is quite high above ground level (14 meters) and is surrounded by other buildings and trees.

2. Yellowstone County personnel delayed the installation of the PM-10 sampler while arrangements were made to move the old Taft School sampling shelter to a grassy area near the Grand Avenue School track. The new shelter provides a much better sampling location than the Grand Avenue School roof where the high volume sampler was located. Once the shelter was moved, equipment problems delayed the startup until June, 1986.

3. The Yellowstone County Air Pollution Control Agency intends to gather at least two years of PM-10 data at this location.

Proposed Sites

1. The department has two additional PM-10 samplers which it intends to deploy during 1986. One of the samplers will be installed at the Columbia Falls site to facilitate an every third day sampling frequency, while the second will be located in Eureka. The department staff prioritized three communities as potential PM-10 sampling locations and chose Eureka as the most important. The three communities included Montana City, West Yellowstone and Eureka. The department will initiate PM-10 monitoring in Eureka during the fall of 1986 and at the other two communities when additional equipment becomes available.

2. The department has monitored TSP in Eureka since 1984. Both state and federal primary standards for TSP have been violated. In order to

determine compliance with the proposed PM-10 standard, the department will install a PM-10 sampler in Eureka during the fall of 1986.

3. The department suspects that particulate concentrations in West Yellowstone are high because of unpaved and dirty streets, heavy automobile traffic relative to the size of the community, and a dependence on wood for home heating. The department believes that the problem is being accentuated by pollution-trapping inversions common to high mountain valleys.

4. In order to establish a good data base and determine the compliance status of the area, the department intends to establish a PM-10 monitoring site in West Yellowstone as soon as additional monitoring equipment is available.

5. The department has performed TSP monitoring at the Montana City School since 1982. TSP levels at this site have repeatedly exceeded the Montana ambient standards. The department suspects that the primary emission sources affecting the site are re-entrained road dust off the unpaved Saddle Mountain Road, the Kaiser Cement plant, and residential wood combustion. Wood smoke and stack emissions from Kaiser Cement are generally fine particulate while fugitive emissions from Kaiser Cement as well as re-entrained road dust generally have larger particle size. A PM-10 monitor would assist in identifying the most important emission sources impacting the site as well as establishing a sound PM-10 data base. The department intends to establish a PM-10 sampler at this location as soon as additional monitoring equipment becomes available.

Lead

The primary sources of ambient lead are automobile tailpipe emissions and the metal mining and processing industry. Since Montana does not have any large cities, automobiles are a relatively minor source of lead. On the other hand, the ASARCO lead smelter and the American Chemet plant in East Helena are major lead emitters. Tailings piles and waste dumps from abandoned mines and mills and the old Anaconda smelter are also potential sources of lead.

Anaconda

1. During July of 1980, a labor strike closed the Anaconda smelter and in September, management announced the permanent closure of the plant. By early 1986, the smelter complex was essentially demolished and removed. The department has monitored lead at the Lincoln School and Highway Junction sites since the sites were established. During April, 1985, the department stopped analyzing the filters from both sites for lead. The primary reasons for terminating the lead analyses were the high cost of the analysis and the low concentrations recorded.
2. During the first quarter of 1985, lead concentrations at the Lincoln School site remained quite low. The January through March quarterly

average concentration was 0.033 ug/m^3. The highest twenty-four hour value was 0.12 ug/m^3. These concentrations are less than 3 percent of the lead ambient standard.

3. The Highway Junction site was re-established during July, 1984 at the request of local residents who complained that high winds were blowing arsenic dust from the smelter during demolition. Although the primary objective was to gather arsenic data during the demolition of the Anaconda smelter, the filters were also analyzed for lead until April, 1985.

4. During the first quarter of 1985, the quarterly mean for lead at the Highway Junction site was 0.056 ug/m^3 and the highest twenty-four hour value was 0.47 ug/m^3. These concentrations are less than four percent of the ambient lead standard.

East Helena

1. The department and the ASARCO lead smelter are presently operating a lead sampling network in the East Helena area as part of the Montana SIP requirements. Table 18 describes the 1985 network, while Figure 24 shows the geographical locations of the sites. The present network is a condensed version of the more elaborate network operated during 1981.

2. The 1981 network was described in the 1982 Network Review and was designed to determine the geographical extent of high ambient lead concentrations. During 1985, the department, with the assistance of ASARCO, operated lead monitors at the South, Hastie, Hadfield, Dartman Field and Firehall sites. The department also performed lead analyses on filters from the Montana City site because it is in the vicinity of East Helena. The Hadfield, Hastie and Firehall sites were operated on

TABLE 18

EAST HELENA LEAD MONITORING NETWORK

Site	Location	Parameters	Equipment	Responsible Organization (Field/Laboratory)
Hastie residence	212 Pacific, .2 mi. north of smelter slag pile	TSP Pb,Cu,Zn,As,Cd Elemental	Hi-vol Hi-vol Lo-vol (shut down 10/13/85)	ASARCO/DHES ASARCO/DHES ASARCO/ASARCO
Hadfield	Hadfield TV Repair, Main Street, .2 mi. north of smelter	TSP Pb,Cu,Zn,As,Cd Elemental	Hi-vol Hi-vol Lo-vol	ASARCO/DHES ASARCO/DHES ASARCO/ASARCO
Firehall	East Helena Firehall, Pacific Street, .2 mi. north of smelter	TSP Pb,Cu,Zn,As,Cd Elemental	Hi-vol Hi-vol Lo-vol	ASARCO/DHES ASARCO/DHES ASARCO/ASARCO
South	Kleffner Field, .5 mi. SSE of smelter	TSP Pb,Cu,Zn,As,Cd	Hi-vol Hi-vol	DHES/DHES DHES/DHES
Dartman Field	North edge of East Helena, .5 miles north of smelter	TSP Pb,Cu,Zn,As,Cd	Hi-vol Hi-vol	DHES/DHES DHES/DHES
Montana City School	4 miles south of East Helena	TSP Pb	Hi-vol Hi-vol	DHES/DHES DHES/DHES

a one-in-three day cycle by ASARCO, while the South, Dartman Field, and Montana City samplers were operated by the department on the standard six-day cycle.

3. The ASARCO sites are equipped with low volume samplers utilizing Teflon filters. These filters are sent to a private laboratory for chemical analysis by X-ray fluorescence and the data are used to perform a chemical mass balance (CMB). The results of the CMB analysis are used to track the lead control strategies on a source specific basis.

4. Table 19 summarizes the 1985 lead data for the East Helena area. The only site which did not violate the state and federal ambient standards during 1985 was the Montana City site. The Firehall site was the only East Helena site which exceeded the standard during every quarter of 1985. In 1984, three of the six sites exceeded the standards during every quarter of the year. The department believes this information, as well as the fact that fifteen of the twenty-two 1985 quarterly averages were less than corresponding data from 1984, indicates lead concentrations are decreasing in East Helena. Apparently, the control strategies being employed by ASARCO, the Montana Department of Highways and the City of East Helena are beginning to work.

TABLE 19

EAST HELENA LEAD DATA FOR 1985
(ug/m^3)

Site	1st Quarter Mean	1st Quarter Max.	2nd Quarter Mean	2nd Quarter Max.	3rd Quarter Mean	3rd Quarter Max.	4th Quarter Mean	4th Quarter Max.
Hastie	2.32	6.04	2.00	6.72	1.42	6.54	1.76	7.64
South	1.85	5.09	0.46	0.70				
Hadfield	3.20	9.05	2.17	7.59	1.87	10.08	1.42	5.91
Dartman Field	2.73	7.14	1.54	4.11	0.67	2.74	1.27	3.10
Firehall	5.46	12.99	3.30	17.08	2.26	11.89	2.26	7.76
Montana City	0.21	0.73	0.04	0.14	0.04	0.18	0.09	0.40

5. During 1981, a detailed chemical mass balance analysis was performed by NEA, Inc. of Beaverton, Oregon, to determine the source contributions at most of the sampling locations. The analysis indicated that re-entrained road dust and soil, fugitive ore concentrates, zinc oxide material, and blast furnace upsets were the primary lead sources.

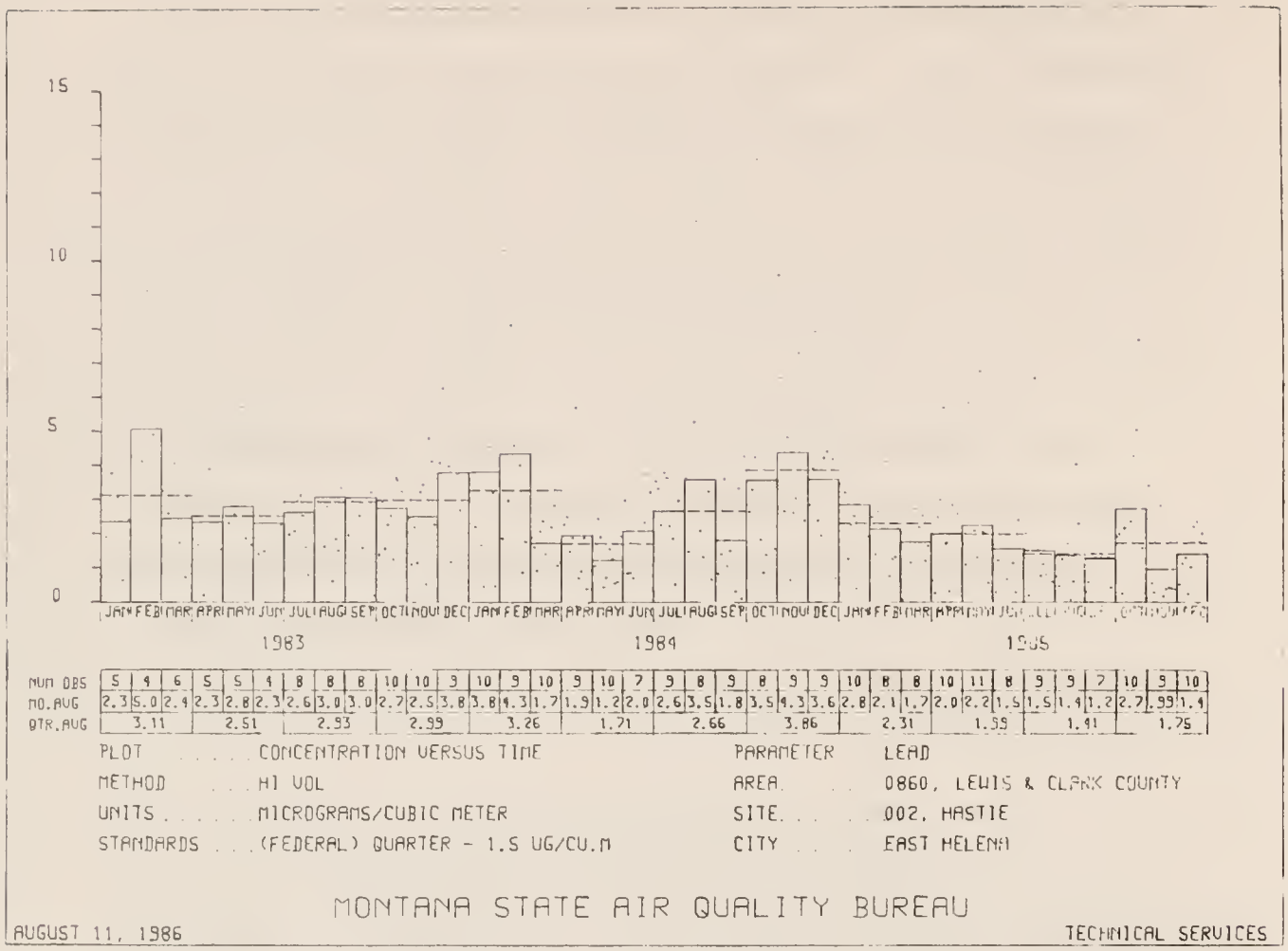
ASARCO repeated the original CMB study during 1983, 1984 and 1985. The second and ongoing study was intended to refine the data from the original study. The results indicate that ore handling, the sinter building, road dust and the blast furnace are significant sources of lead.

6. The Hastie residence sampler monitored ambient lead concentrations in East Helena from 1977 until it was permanently shut down in January, 1986. It was located at 212 Pacific Street, directly across Highway 12 from the ASARCO smelter slag pile. The site has exceeded the 1.5 ug/m^3 quarterly standard over its entire history. In 1985, the highest quarterly mean was recorded during the first quarter and registered 2.32 ug/m^3. This data indicated a 59 percent decrease from 1984. Figure 47 graphically presents the last three years of lead data at the Hastie site.

7. In an effort to save money, the department discontinued TSP and lead monitoring at the Hastie site during January, 1986 and totally disassembled the site in April, 1986. The site usually recorded lower lead values than the nearby Firehall and Hadfield sites and the lead data correlated fairly well with the Firehall site. The department believes that the Firehall and Hadfield sites adequately monitor this part of East Helena. In addition, the Hastie site was being overgrown by trees.

8. The Hadfield monitor is located 0.2 mile north of the ASARCO smelter and the American Chemet plant. It is situated south of Main Street and about five blocks west of the former Hastie site. The lead concentrations at the Hadfield site exceeded the ambient lead standard during

FIGURE 47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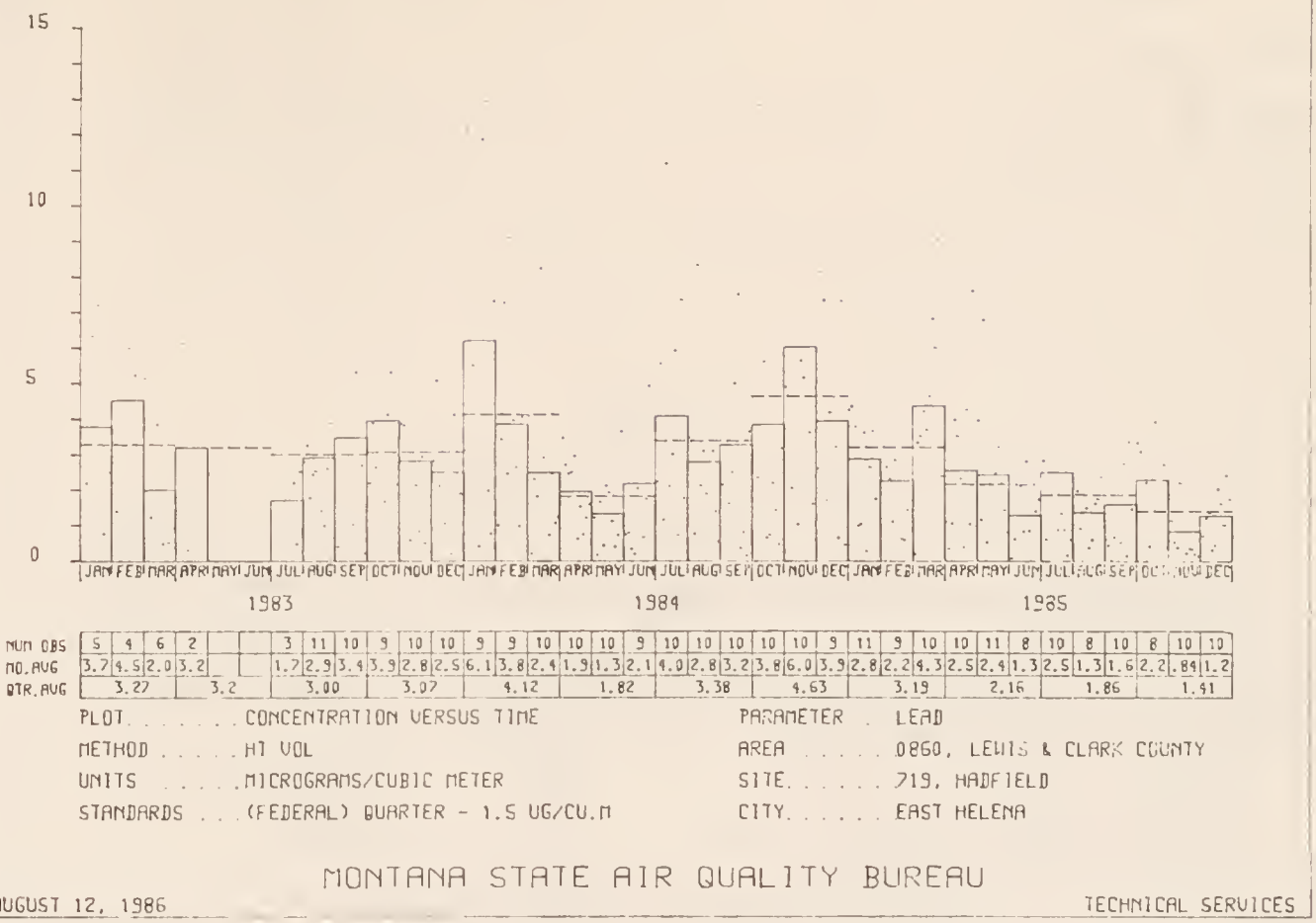
NO.AVG 2.3 5.0 2.4 2.3 2.8 2.3 2.6 3.0 3.0 2.7 2.5 3.8 3.8 4.3 1.7 1.9 1.2 2.0 2.6 3.5 1.8 3.5 4.3 3.6 2.8 2.1 1.7 2.0 2.2 1.5 1.5 1.4 1.2 2.7 .99 1.4
QTR.AVG 3.11 2.51 2.93 2.99 3.26 1.71 2.66 3.86 2.31 1.59 1.91 1.75
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) QUARTER - 1.5 UG/CU.M
PARAMETER LEAD
AREA . . 0860, LEWIS & CLARK COUNTY
SITE. . . . 002, HASTIE
CITY . . . EAST HELENA
MONTANA STATE AIR QUALITY BUREAU
AUGUST 11, 1986
TECHNICAL SERVICES

all but the fourth quarter of 1985. A three year plot of lead data from the Hadfield site is presented in Figure 48.

9. The department will perform lead analyses on the Hadfield high volume filters indefinitely. The department considers the site essential for tracking the lead and TSP control strategies, especially since the Hadfield site recorded the highest TSP readings and second highest lead reading of any of the East Helena sites.

FIGURE 48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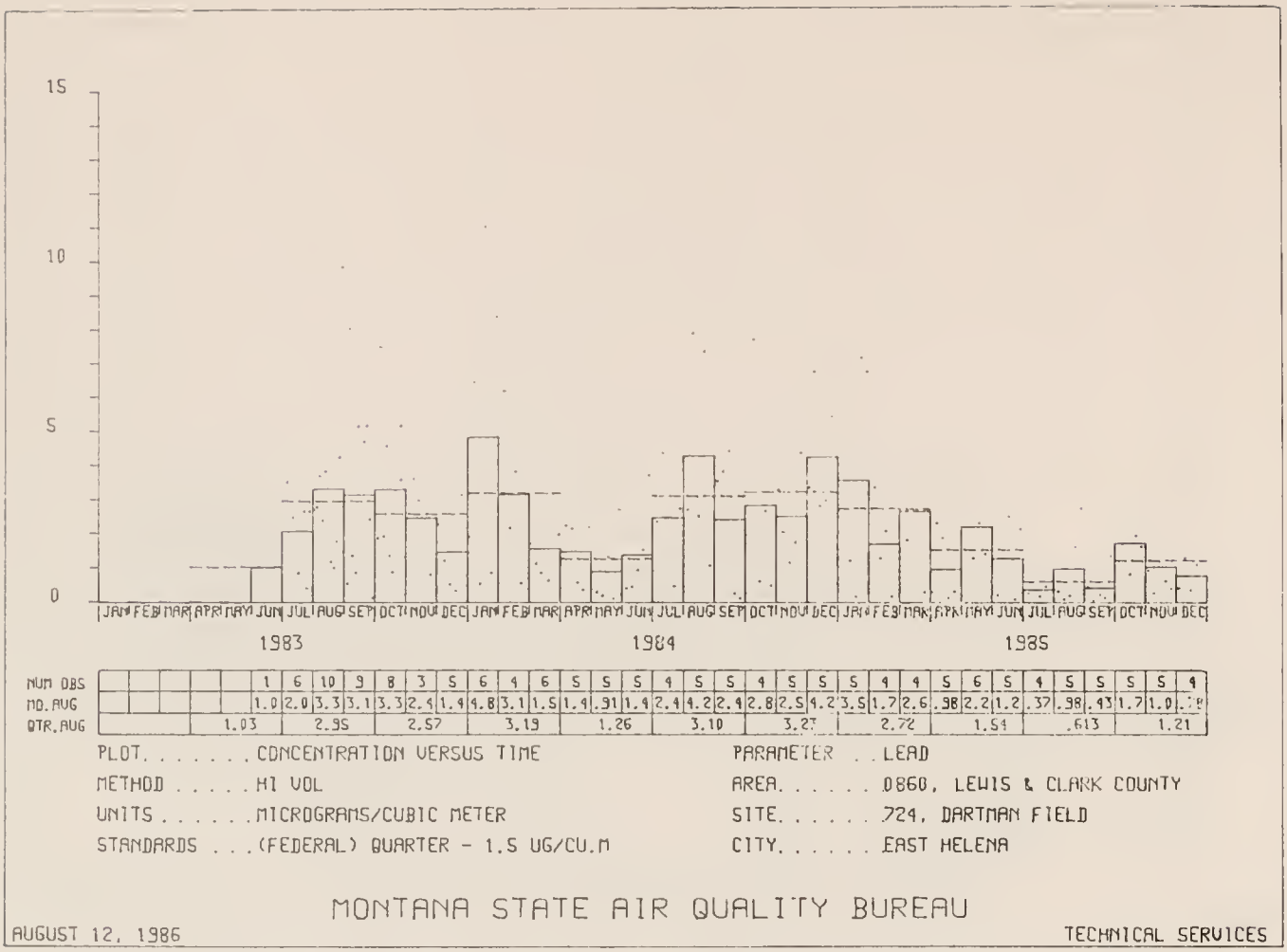
NO.AVG 3.7 4.5 2.0 3.2 1.7 2.9 3.4 3.9 2.8 2.5 6.1 3.8 2.4 1.9 1.3 2.1 4.0 2.8 3.2 3.8 6.0 3.9 2.8 2.2 4.3 2.5 2.4 1.3 2.5 1.3 1.6 2.2 .84 1.2
QTR.AVG 3.27 3.2 3.00 3.07 4.12 1.82 3.38 4.63 3.19 2.16 1.86 1.41
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) QUARTER - 1.5 UG/CU.M
PARAMETER . LEAD
AREA . . . . . 0860, LEWIS & CLARK COUNTY
SITE. . . . . 719, HADFIELD
CITY. . . . . EAST HELENA
MONTANA STATE AIR QUALITY BUREAU
AUGUST 12, 1986
TECHNICAL SERVICES

10. The Dartman Field site is located in a field on the north edge of East Helena. It is approximately 0.5 mile north of the ASARCO smelter. Although this site is located on the opposite side of town from the smelter, it still records high lead concentrations. In 1985, lead data exceeded the standards during the first and second quarters. The highest quarterly reading was observed during the first quarter at 2.73 ug/m^3. Figure 49 is a three year plot of lead data from the Dartman Field site.

FIGURE 49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JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1983
1984
1985
NUM OBS 1 6 10 9 8 3 5 6 4 6 5 5 5 4 5 5 4 5 5 5 4 4 5 6 5 4 5 5 5 5 4
MO.AVG 1.0 2.0 3.3 3.1 3.3 2.4 1.4 4.8 3.1 1.5 1.4 .91 1.4 2.4 4.2 2.4 2.8 2.5 4.2 3.5 1.7 2.6 .98 2.2 1.2 .37 .98 .43 1.7 1.0 .
QTR.AVG 1.03 2.35 2.57 3.19 1.26 3.10 3.27 2.72 1.54 .613 1.21
PLOT. . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) QUARTER - 1.5 UG/CU.M
PARAMETER . . LEAD
AREA. . . . . 0860, LEWIS & CLARK COUNTY
SITE. . . . . 724, DARTMAN FIELD
CITY. . . . . EAST HELENA
MONTANA STATE AIR QUALITY BUREAU
AUGUST 12, 1986
TECHNICAL SERVICES

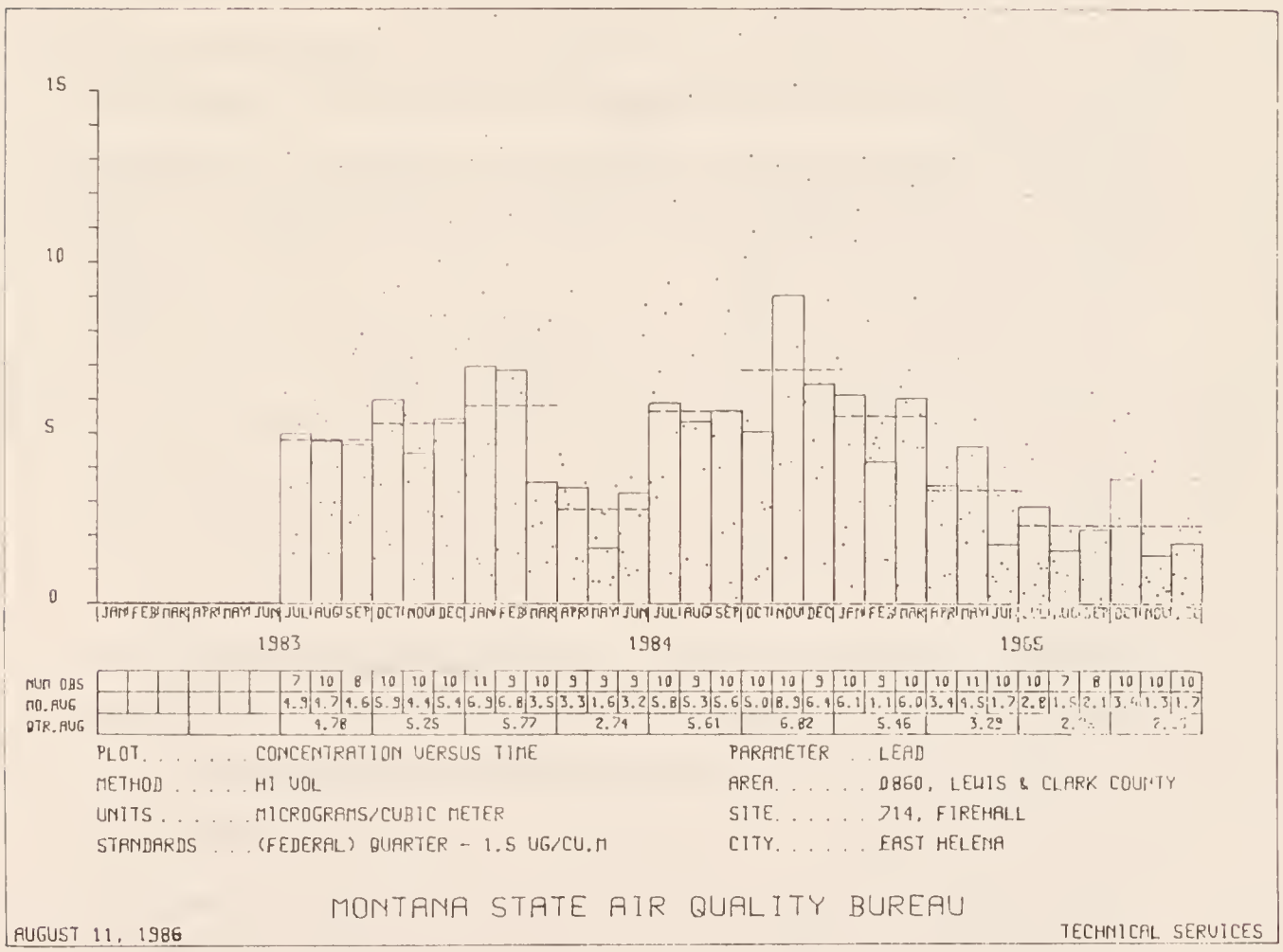
11. The department intends to continue to operate the Dartman Field site to track the East Helena lead SIP. The department believes that this is an important site, especially because it is located farther from the smelter complex and the department suspects that emissions from the main stack may be impacting the sampler.

12. The Firehall site is located on Pacific Street across Highway 12 from the ASARCO smelter and the American Chemet plant. The Firehall site consistently registers the highest lead readings in the state. During 1985, the lead concentrations exceeded the ambient standards during all

four quarters. The highest quarterly mean was 5.46 ug/m³. This value is 3.5 times higher than the standard. Figure 50 is a graphical presentation of the last three years of lead data at the Firehall site.

13. The department, with the assistance of ASARCO, will continue to operate the Firehall site. The Firehall site is a key East Helena site, since the lead control strategies are based on this data.

FIGURE 50

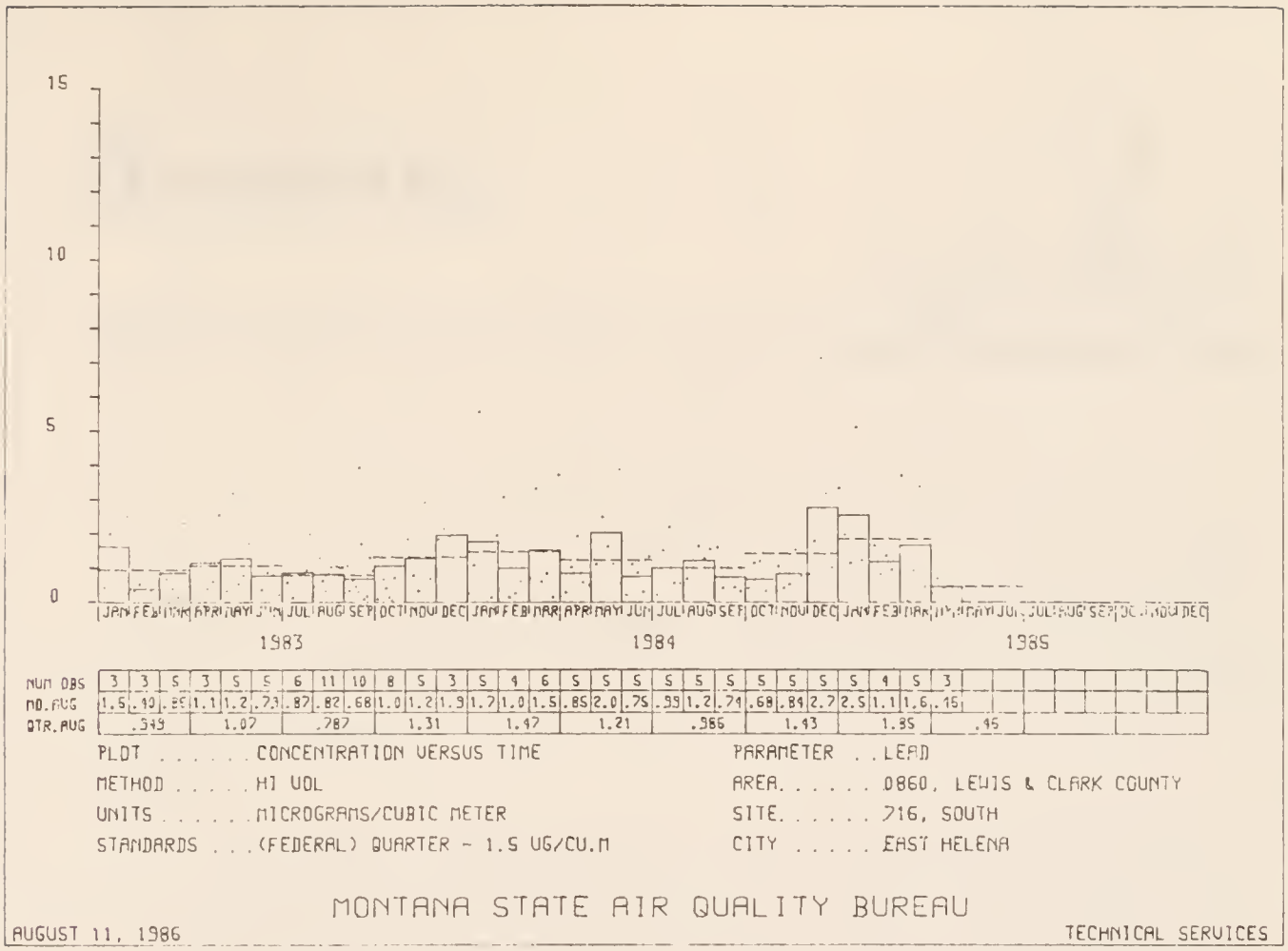


14. The South site was located 0.5 mile south-southeast of the ASARCO smelter complex. During the original lead monitoring effort it was the only site which was not north of the smelter that showed ambient lead violations. The sampler was located in a field and surrounded by agricultural and pasture land. Except for the first quarter of 1985, the lead concentrations at the South site have been in compliance with the lead standards since 1982. In 1985, the highest quarterly average was 1.85 ug/m^3, and occurred during the first quarter. Figure 51 is a three year plot of lead data from the South site in East Helena.

15. The department believes that the South site was impacted by a different set of lead sources than the other East Helena sites. The most likely source is lead-contaminated soils and ore concentrates resuspended by the wind. The South site was located downwind of the smelter complex in relation to the stronger west and northwest winds. The other East Helena sites are influenced more by process emissions from the smelter and the American Chemet plant. The results of the linear regressions discussed in the East Helena TSP section of the 1985 Network Review also indicate that the South site is influenced by different emission sources.

16. Despite the possibility that the South site was monitoring different emission sources, the department shut down the site in April, 1985. The primary reason for terminating the site was to save money on laboratory charges. The department also considered the site unnecessary because the control strategies necessary to achieve compliance at the Firehall will also result in compliance at the South site with a wide margin of safety.

FIGURE 51


15
10
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JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
1983
1984
1985
NUM OBS 3 3 5 3 5 5 6 11 10 8 5 3 5 4 6 5 5 5 5 5 5 5 5 5 4 5 3
MO.AVG 1.5 .10 .35 1.1 1.2 .73 .87 .82 .68 1.0 1.2 1.9 1.7 1.0 1.5 .85 2.0 .75 .99 1.2 .74 .68 .84 2.7 2.5 1.1 1.6 .15
QTR.AVG .549 1.07 .787 1.31 1.47 1.21 .986 1.43 1.85 .45
PLOT . . . . . CONCENTRATION VERSUS TIME
METHOD . . . . . HI VOL
UNITS . . . . . MICROGRAMS/CUBIC METER
STANDARDS . . . (FEDERAL) QUARTER - 1.5 UG/CU.M
PARAMETER . . LEAD
AREA. . . . . 0860, LEWIS & CLARK COUNTY
SITE. . . . . 716, SOUTH
CITY . . . . . EAST HELENA
MONTANA STATE AIR QUALITY BUREAU
AUGUST 11, 1986
TECHNICAL SERVICES

17. The department performed lead analysis on the filters from the Montana City School site during all of 1985. The lead concentrations were relatively low with highest quarterly mean being 0.21 ug/m^3. In light of the low concentrations and in order to save money on laboratory costs, the department stopped analyzing the filters for lead on January 1, 1986.

Arsenic

Arsenic is primarily emitted by smelters and as fugitive dust from mining and smelting activity. In Montana, the ASARCO lead smelter and the shutdown Anaconda copper smelter are the major sources of arsenic. Waste materials from abandoned mines and milling operations can also be sources of windblown arsenic.

Anaconda

1. During 1985, the department operated the Highway Junction site near Anaconda and the Lincoln School site in Anaconda (see Figure 27) to monitor arsenic levels during the demolition of the old Anaconda copper smelter. The department received numerous complaints from local residents concerning windblown arsenic-laden dust. As a result, the department ran an additional high volume sampler at the Highway Junction site and the Mill Creek site to monitor arsenic levels on windy days. These samplers were only started when the local operator noticed tailings or dust from the demolition activity being whipped into the air. In addition, ARCO analyzes the filters from their samplers at the Lincoln School, Mill Creek and Johnson Curve sites for arsenic.

2. The department installed the high volume sampler at the Highway Junction site in July, 1984. The highest twenty-four hour arsenic concentration during 1985 was 0.34 ug/m^3. The arithmetic mean for the year was 0.04 ug/m^3. Although these concentrations are not alarming, they are slightly elevated and continued monitoring is warranted. Neither Montana nor the federal government have promulgated ambient standards for arsenic.

3. The department initiated arsenic analysis on the high volume sampler filters from the Lincoln School site during April, 1985. The maximum twenty-four hour concentration recorded during 1985 was 0.22 ug/m^3. The mean concentration for 1985 was 0.01 ug/m^3.

4. The department intends to continue arsenic analysis on a routine basis at the Highway Junction site. However, the Lincoln School site was shut down in June, 1986, since ARCO is monitoring TSP and trace metals at the same location. The special purpose monitors at Mill Creek and the Highway Junction sites which were run only on windy days have been moved to locations just east of the flue dust vault and across Highway 10A from the old smelter main gate. The site near Highway 10A will track fugitive emissions off of a stockpile of arsenic-laden dust located nearby. The dust will be transported to the vault during 1987. The other sampler will record any fugitive emissions off the vault itself.

East Helena

1. Although the primary purpose of the East Helena high volume sampling network is to monitor TSP and lead, the department also analyzed the filters for other trace metals including arsenic (see Figure 24). In

order to save money, the department terminated all arsenic monitoring in East Helena during April, 1985. Table 20 summarizes the arsenic data for the first three months of 1985 in East Helena. The highest arsenic levels were recorded at the Firehall site. The annual arithmetic mean was 0.421 ug/m^3 and the highest twenty-four hour value was 2.710 ug/m^3.

TABLE 20

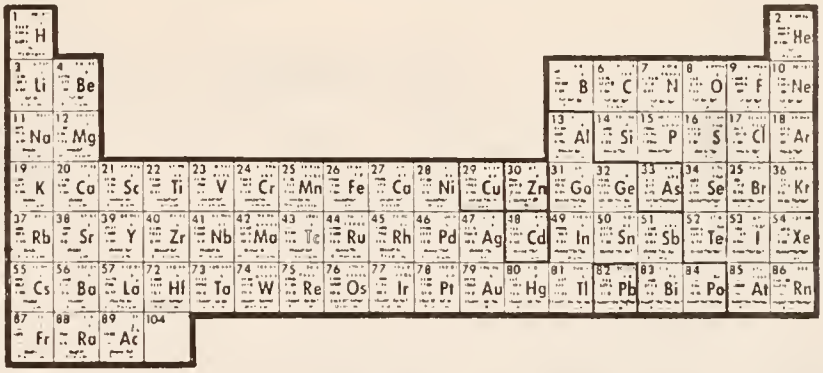
1985 ARSENIC DATA FOR EAST HELENA SITES
(ug/m^3)

Site	No. of Observations	Arith. Mean	Maximum
Hastie	26	0.129	0.372
Firehall	29	0.421	2.710
South	15	0.116	0.399
Dartman Field	14	0.152	0.413
Hadfield	30	0.205	0.524

2. In the 1985 Network Review, the department used linear regression analyses to compare arsenic data among the East Helena sites. Linear regression analyses were also performed to compare arsenic concentrations with TSP and other trace metals at the same site. The results are discussed in the 1985 Network Review in the East Helena section on TSP. The analyses indicated that arsenic and lead data correlate well and therefore it is not surprising that the Firehall site also recorded the highest lead values.
3. As a cost-cutting measure, the department stopped analyzing the East Helena filters for arsenic in April, 1985. The department also terminated other trace metal analyses in East Helena except for copper

and zinc at the Firehall site. The department intends to reinitiate arsenic and cadmium monitoring at the Firehall site in East Helena. In addition, the department will review the trace metal data being obtained by ASARCO from low volume sampler filters.

Trace Metal



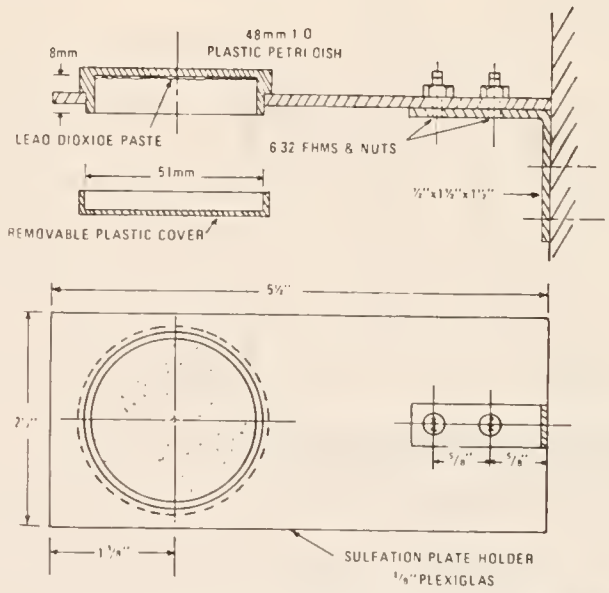
In 1985, the department analyzed high volume sampler filters for various trace metals at the Highway Junction site in Anaconda, at all the East Helena sites and at Thompson Falls. The department analyzed the Thompson Falls filters for trace metals because the Sanders County Courthouse is the nearest monitoring site to the U.S. Antimony plant located twelve miles up Prospect Creek. The data is summarized in Table 21. In April, 1985, the department stopped analyzing for most trace metals due to the high laboratory costs. The department is still sampling for lead at all the operating East Helena sites and arsenic at the Anaconda sites. The department will reinitiate arsenic and cadmium monitoring and also continue to analyze for copper and zinc at the East Helena Firehall site. All other trace metal analysis has been terminated.

TABLE 21

1985 TRACE METAL DATA
(Arithmetic Means in ug/m^3)

Site	City	Aluminum	Antimony	Cadmium	Chromium	Copper	Iron	Zinc
Sanders Co. Crths.	Thompson Falls		0.013					
Hastie	East Helena			0.093		1.898		1.773
Firehall	East Helena			0.186		5.886		1.553
South	East Helena			0.073		0.507		0.647
Hadfield	East Helena			0.135		3.528		2.783
Dartman Field	East Helena			0.084		1.937		1.221
Highway Junction	Anaconda	0.248		0.002	0.005	0.265		0.164

Sulfation Rate



In addition to continuous sulfur dioxide monitors, the department will continue to use sulfation plates as inexpensive indicators of sulfur emissions. Yellowstone County intends to continue their existing network of sulfation plates near Billings and Laurel and, with assistance from the department, operate an expanded network from September through December, 1986. Since continuous monitoring of sulfur dioxide is limited to three sites in the Billings and Lockwood areas and none near Laurel, the sulfation plates are very important.

The department has initiated duplicate sampling at some sulfation plate sites to eliminate data loss due to the sulfation plates being lost or damaged by the wind. Although the department will continue this practice, in the future we will only analyze one of the plates except for an occasional precision check. This procedure will save money in laboratory charges.

Billings

1. Yellowstone County, with the assistance of the department, intends to temporarily enlarge the Billings/Laurel/Lockwood sulfation plate network in order to develop an intensive data base over a wide geographical area. Such a data base will allow both agencies to draw an area map displaying isopleths (lines of equal concentrations) of the sulfation rate. Since sulfation rate is an excellent indicator of sulfur dioxide concentrations, the agencies will be able to assess the impact of sulfur dioxide emissions over the entire area. Such an assessment might include estimates of population exposure and crop and range impacts. The data will also provide additional benefits in regard to future site selection for sulfur dioxide monitoring and evaluating the results of dispersion modeling. Figure 52 shows the existing network as well as the proposed sites.
2. Yellowstone County and the department decided to enlarge the sulfation plate network because of several recent developments and subsequent data needs. They include:
   a. Several legislators criticized the department during the 1986 special session for siting sulfur dioxide monitors in areas of maximum concentration which are not representative of the major population areas. The department makes no apology for locating sites in areas of maximum concentration since that is one of our primary monitoring objectives. In addition, the Lockwood Park site is in the center of a densely populated area. However, the isopleth map mentioned above will allow the department to estimate the area and population represented by each monitoring site.

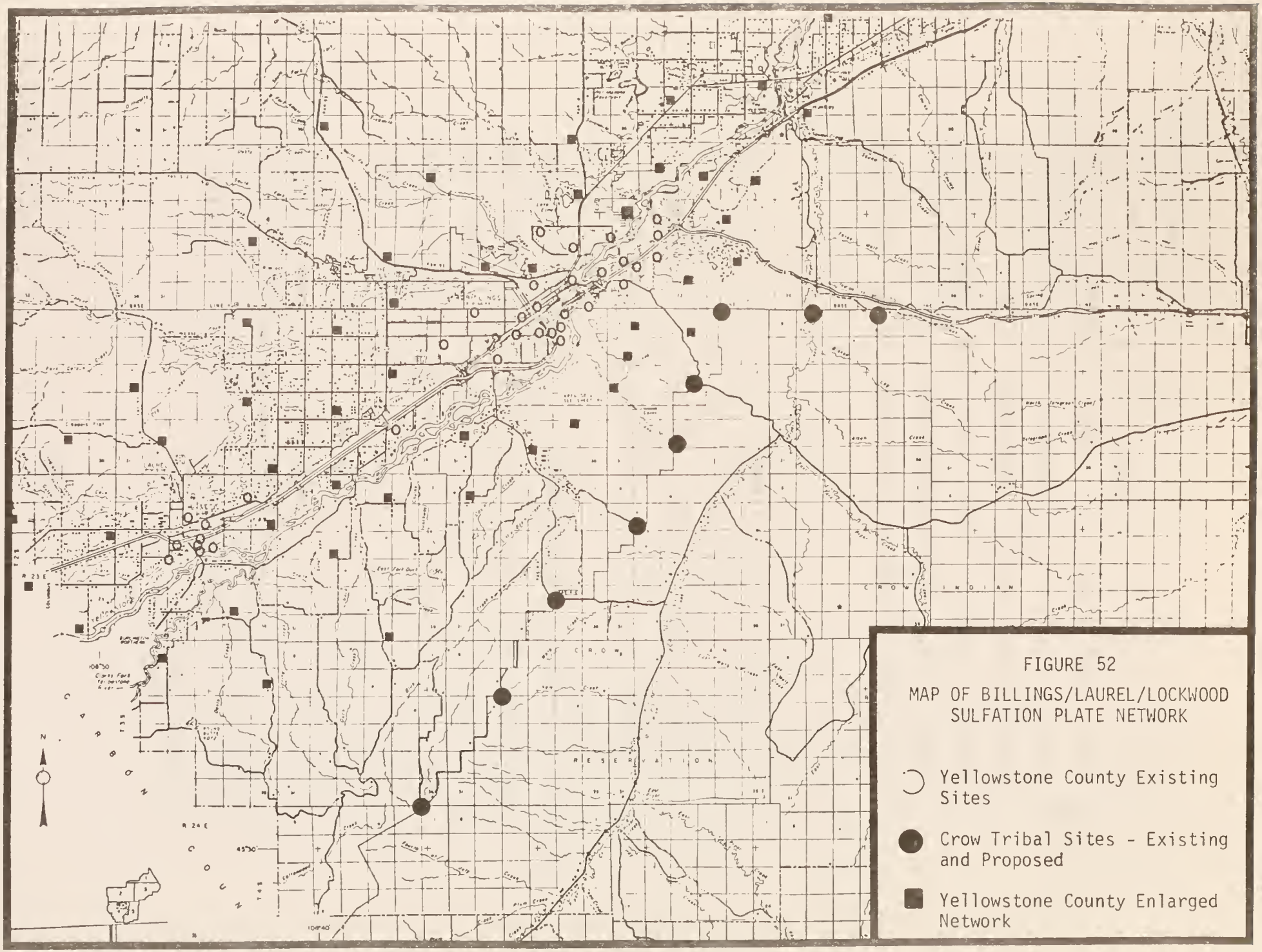


FIGURE 52

MAP OF BILLINGS/LAUREL/LOCKWOOD
SULFATION PLATE NETWORK

Yellowstone County Existing Sites

Crow Tribal Sites - Existing and Proposed

Yellowstone County Enlarged Network

b. Testimony before a legislative committee by several members of the public indicated that crop damage is likely at the sulfur dioxide levels common in the Billings area. The isopleth map will allow the department to estimate the number of acres being subjected to various concentrations of sulfur dioxide.

c. The isopleth map will be a valuable tool for evaluating the reasonableness of dispersion modeling results.

d. The isopleth map will be useful for locating any future monitoring sites.

e. Three sulfation plate sites located 5-7 miles southeast of Billings on the Crow Reservation have measured significant concentrations, indicating that the impact from the major sulfur dioxide emitting industries extends a considerable distance from the sources and may be especially significant at higher elevations.

3. Yellowstone County and the department plan to deploy the enlarged network on September 1, 1986, and operate it at least until December 31, 1986. The months of September through January have historically recorded the highest sulfation rates and sulfur dioxide concentrations. The agencies will continue to operate the network during January as long as snow cover does not present an access problem.

4. Yellowstone County and the department intend to develop isopleth maps for each of the months and for the entire periods. The four-month composite map will be developed for maximum concentrations and for the four-month average.

Scobey

1. The department will operate a sulfation plate network near Scobey. The department started the Scobey network in July, 1984, and will run it at least until June, 1987. The department will be able to inexpensively track sulfur dioxide concentrations near Scobey until Legacy Fund monies are available to restart continuous monitoring, probably in September, 1986. When continuous monitoring is reinitiated, the sulfation plates will still be used to expand the data base over a wider geographical area.

Sidney

1. The department modified the Sidney network during April, 1985, by eliminating all but three sites and starting three new ones. The new sites are located in the Yellowstone River Valley downstream from Sidney and on the higher terrain to the east. The department suspected that winds down the Yellowstone Valley carry sulfur emissions from the Sidney area sources to the new valley locations. On the other hand, several of the sources have tall stacks and the department believed emissions could be impacting the higher terrain. The data gathered over the past year indicates that neither hypothesis was correct. The sulfation rate has remained low at the original sites as well as the new sites. The highest sulfation rate was 0.09 mg/100 cm^2/day recorded at the Ludington site in December, 1985, and the Peterson-Morlock site in August, 1985. In light of the low sulfation rates, the department shut down the Sidney sulfation plate network during July, 1986.

Choteau

1. Until February, 1986, the department maintained a sulfation plate for the Bureau of Land Management (BLM) at the Circle 8 Guest Ranch 30 miles northwest of Choteau. This section of the Rocky Mountain Front is experiencing extensive oil and gas exploration. However, due to difficulties obtaining spending authority for the BLM funds, the department decided not to participate in the project.

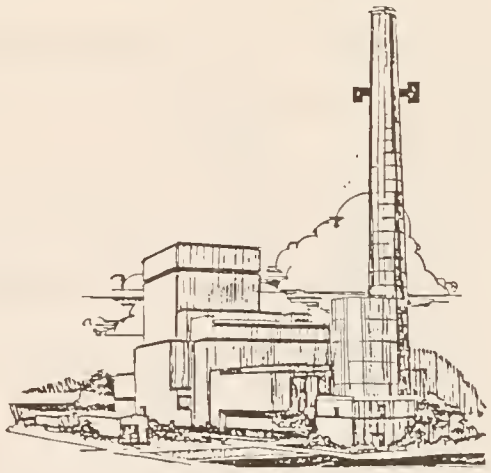
Oilmont

1. During 1985, the department performed sulfation rate monitoring in the vicinity of the Northern Montana Gas plant near Oilmont, Montana. The highest monthly value was 0.22 mg/100 cm^2/day and was recorded during January, 1985. The department will continue to operate this site due to public complaints in the area and the moderate sulfation rates.

Prospective Sites

1. The department may occasionally install sulfation plates on a short-term basis in response to odor complaints. Many of the odor complaints we receive involve hydrogen sulfide from oil well venting or other sulfur compounds resulting from incomplete combustion of hydrogen sulfide during flaring. Although sulfation plates are designed to measure sulfur dioxide, they also react with other sulfur compounds, but to a lesser degree.

Sulfur Dioxide



In 1985, the department monitored sulfur dioxide at Scobey and Billings. The department also receives sulfur dioxide data from several companies in accordance with their air quality permits. These companies monitored sulfur dioxide in Missoula, East Helena, Colstrip and northwest of Sidney.

In Montana the major sources of sulfur dioxide are coal-fired power plants, oil refineries, sugar beet factories, a lead smelter, a pulp mill, and oil and gas field emissions. Table 22 is a list of the major sulfur dioxide emitting industries throughout Montana.

Scobey

1. In 1976, the department initiated sulfur dioxide monitoring at two sites near Scobey as part of the Poplar River Basin Environmental Impact Study. The sites were temporarily shut down from June, 1983, to July, 1984 and again from June, 1985, to the present. The department expects state funding to be available to reopen one site during September, 1986. In the meantime, the department is operating a network of sulfation plates.

TABLE 22

1985 POINT SOURCE SULFUR DIOXIDE EMISSION ESTIMATES

Source	Tons/Yr	County	City
Exxon Co., USA	16812	Yellowstone	Billings
Montana Power Co. (Corette)	5367	Yellowstone	Billings
Farmers' Union CENEX	8357	Yellowstone	Laurel
Continental Oil Co. (CONOCO)	3872	Yellowstone	Billings
Montana Sulfur	2130	Yellowstone	Billings
Western Sugar	879	Yellowstone	Billings
Westmoreland Resources	* 33	Big Horn	Hardin
East Decker Coal	* 39	Big Horn	Decker
West Decker Coal	* 20	Big Horn	Decker
Montana Refining	965	Cascade	Great Falls
Union Oil of California	136	Glacier	Cut Bank
ASARCO	28740	Lewis & Clark	East Helena
Ideal Basic Industries	472	Gallatin	Trident
Kaiser Cement	374	Jefferson	Montana City
Montana Power Colstrip 1&2	4424	Rosebud	Colstrip
Oil and gas flaring	1700-5000	Williston Basin**	
Montana Dakota Utilities	3659	Richland	Sidney
Shell Oil	1186	Richland	Sidney
Western Energy Coal	* 63	Rosebud	Colstrip
Peabody Coal	* 27	Rosebud	Colstrip
Montana Power Colstrip #3	1644	Rosebud	Colstrip
ARCO Aluminum	1775	Flathead	Columbia Falls
Stone Container, Packaging Div.	1674	Missoula	Frenchtown
W. R. Grace	373	Lincoln	Libby
Champion International Corp.	13	Lincoln	Libby

*Includes tailpipe emissions from diesel powered vehicles.
**Estimated emissions for oil field gas flaring in the Williston Basin.

2. The two sulfur dioxide sites which operated in 1985 are the Border site, located on the Canadian border north of Scobey, and the Hanrahan site, 13 miles northeast of Scobey. The sites were originally established to gather baseline data prior to the startup of two 300 megawatt coal-fired power generating units at Coronach, Saskatchewan.

These sites were chosen as possible areas of high sulfur dioxide concentrations based on dispersion modeling performed by a department contractor. Figure 44 shows the location of the Scobey area monitoring sites.

3. During 1985, sulfur dioxide concentrations remained very low at both sites. The maximum one-hour concentrations were 0.127 ppm at the Border site and 0.031 ppm at the Hanrahan site. These readings occurred during January at both sites. Table 23 summarizes the 1985 sulfur dioxide data for the Scobey area. Figure 53 is a diurnal plot of January sulfur dioxide readings from the Border site. The department suggests that this plot be reviewed in conjunction with some of the Billings sulfur dioxide plots. Such a comparison emphasizes just how low the Scobey sulfur dioxide concentrations are.

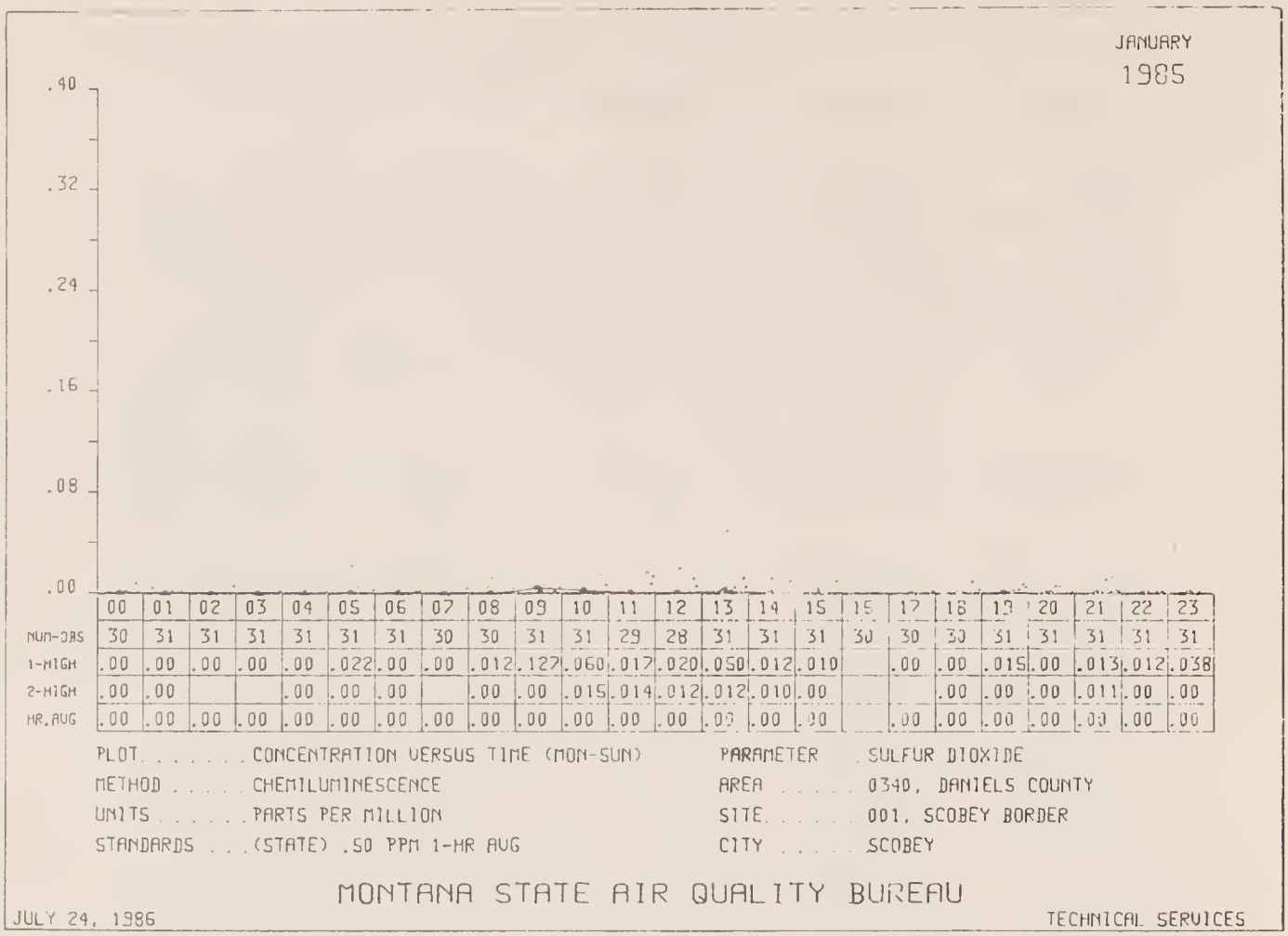
4. The 1985 Montana Legislature authorized Legacy Fund monies for a scaled-down monitoring project for Scobey. The money is expected to be available in September, 1986. The funding will be sufficient to operate one site for six to twelve months. During the interim, the department continues to operate a sulfation plate network.

TABLE 23

SUMMARY OF 1985 SULFUR DIOXIDE DATA FOR SCOBEY

Site	Number of Observations	1-hour Max.	3-hour Max.	Running 24-hr. Max.	Daily Max.	Annual Mean
Border	3865	0.127	0.064	0.009	0.009	0.001
Hanrahan	4078	0.031	0.027	0.008	0.007	0.001

FIGURE 53



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	30	31	31	31	31	31	31	30	30	31	31	29	28	31	31	31	30	30	30	31	31	31	31	31
1-HIGH	.00	.00	.00	.00	.00	.022	.00	.00	.012	.127	.060	.017	.020	.050	.012	.010		.00	.00	.015	.00	.013	.012	.038
2-HIGH	.00	.00			.00	.00	.00		.00	.00	.015	.014	.012	.012	.010	.00			.00	.00	.00	.011	.00	.00
HR.AVG	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		.00	.00	.00	.00	.00	.00	.00

PLOT . . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . SULFUR DIOXIDE
AREA . . . . . 0340, DANIELS COUNTY
SITE . . . . . 001, SCOBEY BORDER
CITY . . . . . SCOBEY

MONTANA STATE AIR QUALITY BUREAU

JULY 24, 1986 TECHNICAL SERVICES

Billings

1. Sulfur dioxide monitoring has been conducted in Billings and Laure since 1974. In 1978, the Laurel area was designated nonattainment for the primary national ambient air quality standard for sulfur dioxide. Concurrently, a stipulation was signed between the department and the major sulfur dioxide emitting industries in the vicinity of Billings and Laurel. The stipulation provided for a one-year study to more fully describe the magnitude and geographical extent of sulfur dioxide concentrations. Another major goal of the study was to identify the relative source contribution from each industry.

2. The study did not get underway until September, 1981. Through a cooperative effort, the affected industries and the department designed and installed an entirely new sulfur dioxide sampling network. The air monitoring portion of the study was performed by GeoResearch Inc. of Billings under subcontract to Rockwell International, and by the department. The air monitoring portion of the study was completed in September, 1982. The results indicated that the Laurel area was in compliance with state and federal sulfur dioxide standards while Billings and Lockwood are exceeding the state standards. However, the department is still analyzing the data to determine what percentage of the sulfur dioxide concentrations at each monitoring site originate from each industry.

3. Since 1982, the department has operated a scaled-down sulfur dioxide network. The department stopped all sulfur dioxide monitoring in Laurel and ran four sites in the Billings and Lockwood areas. In December, 1983, the network was reduced even further to three sites. The department shut down all of the Laurel sites because the data indicated compliance with all state and federal standards. The present network consists of the Coburn Road, Lockwood Park, and North Johnson Lane sites (see Figure 39).

4. The 1977 stipulation required the department to validate a mathematical model so that the model predicts actual concentrations reasonably well. The department was to use the validated model to determine the sulfur dioxide contribution from each emission source and to subsequently design control strategies. During 1983 and 1984, the department pursued two different modeling approaches: dispersion modeling using

the standard Complex I and Complex II EPA-approved models and a directional model developed by the department. The results of both analyses are described in detail in a report entitled "Billings SO_2 Study, Data Analysis, Model Validation, and Source Determination (Draft)."

5. The department chose the Complex I and Complex II models because they are the only EPA-approved models which are designed for multiple emission sources, hourly sequential emission and meteorological data, and rough terrain. The department obtained emissions data from each of the industries and used a composite meteorological data set based on the Taft School site for input to the model. The department ran the Complex models to predict twenty-four hour concentrations for November, 1981, and January, May and August, 1982. The department compared the predicted concentration at each monitoring site to the actual concentrations using linear regression analyses. The results of the analyses were disappointing. The models generally underpredicted and the correlation coefficients were very poor. The department also believed that the source contribution percentages were unrealistic. The department suspects that the models performed poorly for several reasons including: 1) the models overpredict plume rise, 2) the models are not designed to handle inversion breakups (fumigation), and 3) the receptors are so close to the sources that small errors in wind direction can result in large differences in predicted versus actual concentrations. The ambient sulfur dioxide and meteorological data indicate that a large share of the ambient sulfur dioxide concentrations occur during fumigations.

With this in mind, the department and the Billings industries decided to execute the models for the Laurel BN site and the Coburn Road site only during periods with steady winds greater than three meters per second and blowing from the sources to the site. Since dispersion models were designed for these conditions, all parties felt that if the models were to work at all, they would work under these conditions The results were even more disappointing. The correlations were even worse and, in some cases, negative.

The industries remain optimistic that a dispersion model can be validated but the department is skeptical.

6. The second modeling approach pursued was developed by the department. The department based the model on the Coburn Road site in Billings and the BN site in Laurel. These sites recorded the highest sulfur dioxide readings in their respective areas.

The department determined that approximately 90 percent of the sulfur dioxide concentrations registered at the Coburn Road and Laurel BN sites occurred during southwest or northeast winds. The department arrived at this conclusion by developing a parameter known as a "percent strength factor." The strength factor is the mean of the sulfur dioxide readings (from one of 16 compass directions) times the percent of time the wind blew from the applicable direction. The percent strength factor is obtained by adding up the individual strength factors and dividing each by the total times 100. Table 24 shows the percent strength factors for the southwest and northeast directions.

TABLE 24

PERCENT STRENGTH FACTOR FOR COBURN ROAD

	SW	NE	SW + NE
January	56.7%	38.7%	95.4%
May	51.0	33.4	84.4
August	34.6	48.9	83.5
November	81.4	9.7	91.1
Average	55.9%	32.6%	88.5%

The department divided the sulfur dioxide sources into three subareas (Laurel, Billings, and Lockwood) to allow for a directional analysis. Therefore, at Coburn Road, the following equations are appropriate.

$$\frac{SW}{NE} = \frac{55.9}{32.6} = 1.71 = \frac{A + B}{C} \quad \text{and}$$

$$A + B + C = 0.29 \text{ ppm}$$

where: SW and NE = percent strength factors from each direction

A = Laurel
B = Billings = the annual contribution of sulfur dioxide from each subarea
C = Lockwood

0.029 ppm = the annual average concentration at Coburn Road

Since the Taft School site is located between the Laurel emission sources (area A) and the Billings emission sources (area B), the department considered that all of the sulfur dioxide recorded at Taft School during southwest winds was from Laurel. The average concentration recorded during southwest winds was 0.004 ppm. Since the Taft School site and the Coburn Road site are near each other in relationship to Laurel, the department assumed 0.004 ppm was the concentration at Coburn from Laurel. The department then solved the two equations above simultaneously and obtained the following results for Coburn Road:

A = 0.004 ppm
B = 0.014 ppm
C = 0.011 ppm

Since two of the areas had more than one emission source, the department determined source specific contributions based on plant emission rates. A similar procedure was used for the Laurel BN site and the results for both sites are shown in Table 26. This analysis indicates that the Exxon Refinery and the Montana Power Co. Corette Plant are the primary sources impacting the Coburn Road site. The department must point out, however, that this technique does not consider dispersion, vertical mixing, or the relationship between source and receptor heights.

TABLE 25

PERCENT CONTRIBUTION TO AMBIENT SULFUR DIOXIDE CONCENTRATIONS BY SOURCE

Emission Source	Coburn Rd.	Laurel BN
Montana Power Co.	27.4%	5.8%
Conoco	18.0%	3.8%
Western Sugar	2.8%	0.6%
Exxon	29.0%	8.9%
Montana Sulphur	8.8%	2.7%
CENEX	13.8%	78.0%

7. The department is presently designing control strategies based on the department's directional model. However, the existence of a validated dispersion model would have two advantages over the department's directional model in that it could predict sulfur dioxide concentrations at any location and would be a valuable future planning tool.

8. The Coburn Road site is located on the top of a ridge which separates the city of Billings from the Lockwood area. The Conoco oil refinery, the Montana Power Co. Corette Plant, and the Western Sugar refinery are sulfur dioxide sources which are located on the Billings side of the ridge within two miles of the monitoring site. On the other side of the ridge in Lockwood are the Exxon oil refinery and the Montana Sulphur and Chemical Company. Both of these sulfur dicxide sources are approximately two miles northeast of the Coburn Road site. The site is at an elevation of 3380 feet MSL or approximately 280 feet above the surface of the Yellowstone Valley. Wind patterns at the Coburn Road site are somewhat different than at the other sites located within the valley. In general, the wind speed is 0.5 to 1.0 meter per second faster with a much greater predominance from the west-southwest. Apparently, terrain features have much less effect on wind at the Coburn Road site.

9. In 1985, the sulfur dioxide concentrations at Coburn Road were the highest in the state for each averaging period (see Table 26). During 1985, sulfur dioxide concentrations at the Coburn Road site were in violation of the Montana twenty-four hour standard (see Table 27). Sulfur dioxide concentrations also exceeded the Montana annual average standard but insufficient data was collected to establish a valid annual average. Figures 54, 55, 56 and 57 show the diurnal distributions of sulfur dioxide concentrations at Coburn Road for January, March, July and October, 1985. It can be observed from these plots that winter concentrations are higher than summer and that peak concentrations generally occur before noon. However, the diurnal concentrations are more erratic during January.

TABLE 26

SUMMARY OF 1985 SULFUR DIOXIDE DATA FOR BILLINGS

Site	No. of Observations	1-hour Max.	3-hour Max.	Running 24-hr.Max.	Daily Max.	Annual Mean
North Johnson Lane	7162	0.414	0.303	0.143	0.131	0.018
Lockwood Park	7444	0.494	0.406	0.167	0.115	0.021
Coburn Road	6491	0.996	0.845	0.203	0.142	0.025

TABLE 27

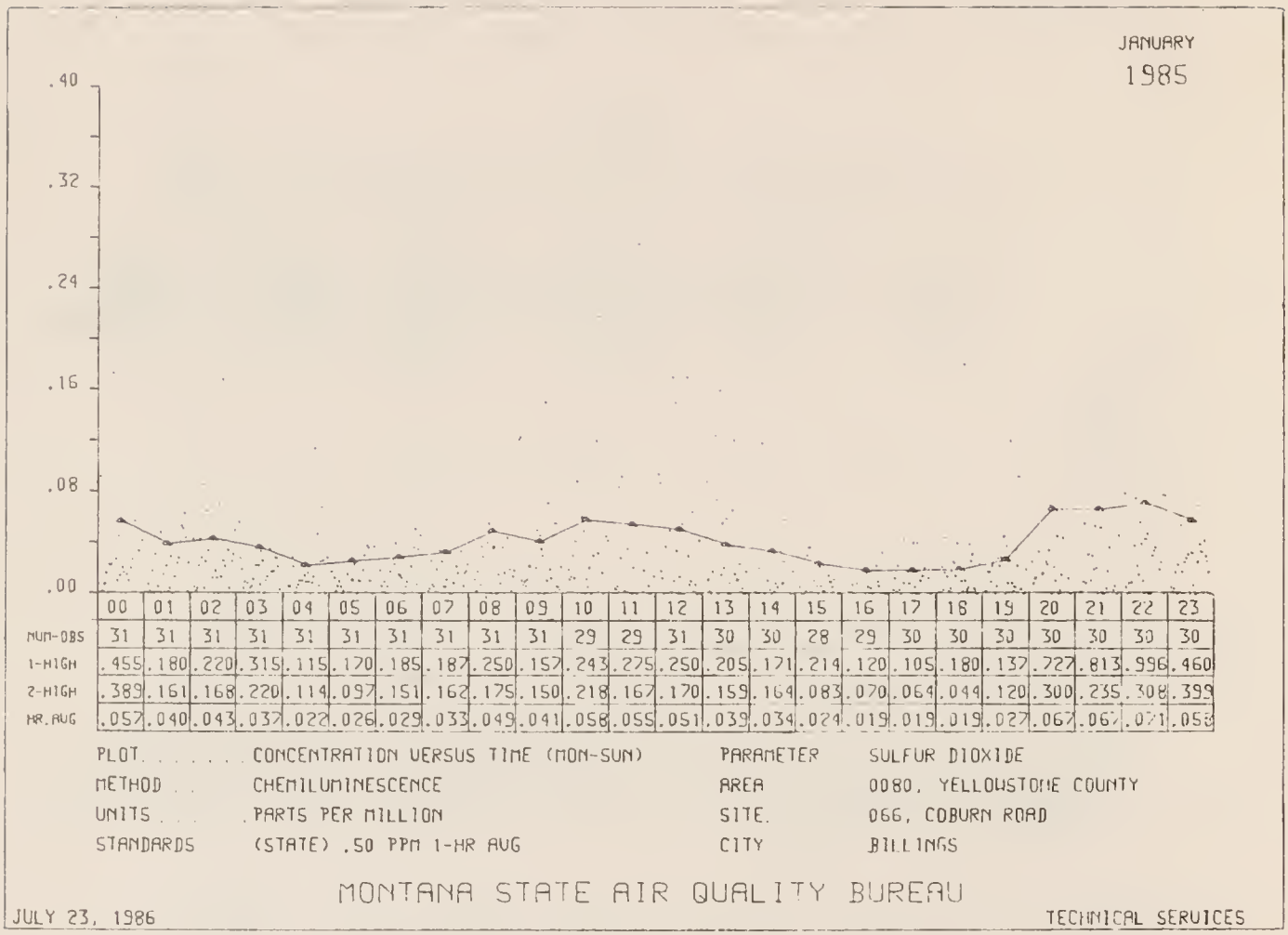
1985 EXCEEDANCES OF SULFUR DIOXIDE STANDARDS IN BILLINGS[1]

Site	Montana 1-hour Standard[2]	Montana 24-hour Standard[3]	Montana Annual Standard[4]	Federal 3-hour Standard[3]	Federal Daily Standard[3]	Federal Annual Standard
North Johnson Lane	0	7	0	0	1	0
Lockwood Park	0	3	1	0	0	0
Coburn Road	4	4	1	1	1	0

[1] This table shows all exceedances prior to eliminating the below exemptions.
[2] Eighteen excursions over the standard are allowed before a violation exists.
[3] One excursion over the standard is allowed before a violation exists.
[4] Although sulfur dioxide concentrations exceeded the annual standard at Lockwood Park and Coburn Road, there was insufficient data to constitute a valid annual average.

10. The department suspects that the Coburn Road site is located at an optimum elevation, so that during periods of multiple layered inversions, the plumes of the various sources are trapped in a layer at the same height. This might explain why sulfur dioxide concentrations at Coburn Road are generally higher and often do not follow the concentrations at the other valley locations.

FIGURE 54



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	31	31	31	31	31	31	31	31	31	29	29	31	30	30	28	29	30	30	30	30	30	30	30
1-HIGH	.455	.180	.220	.315	.115	.170	.185	.187	.250	.157	.243	.275	.250	.205	.171	.214	.120	.105	.180	.137	.227	.813	.996	.460
2-HIGH	.389	.161	.168	.220	.114	.097	.151	.162	.175	.150	.218	.167	.170	.159	.164	.083	.070	.064	.044	.120	.300	.235	.308	.399
HR.AVG	.057	.040	.043	.037	.022	.026	.029	.033	.049	.041	.058	.055	.051	.039	.034	.024	.019	.019	.019	.027	.067	.062	.071	.058

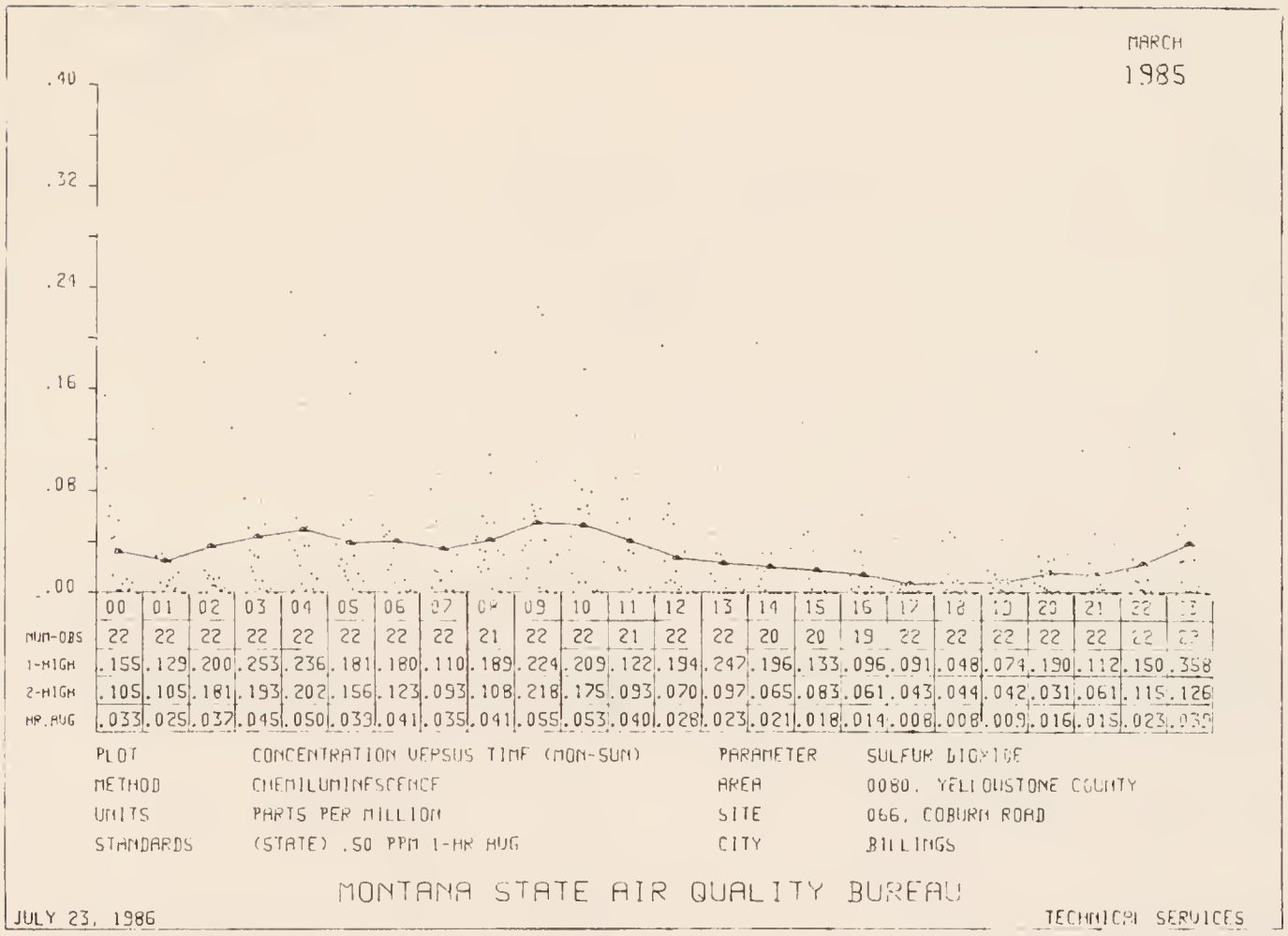
PLOT . . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . CHEMILUMINESCENCE
UNITS . . . PARTS PER MILLION
STANDARDS (STATE) .50 PPM 1-HR AVG

PARAMETER SULFUR DIOXIDE
AREA 0080, YELLOWSTONE COUNTY
SITE. 066, COBURN ROAD
CITY BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

FIGURE 55



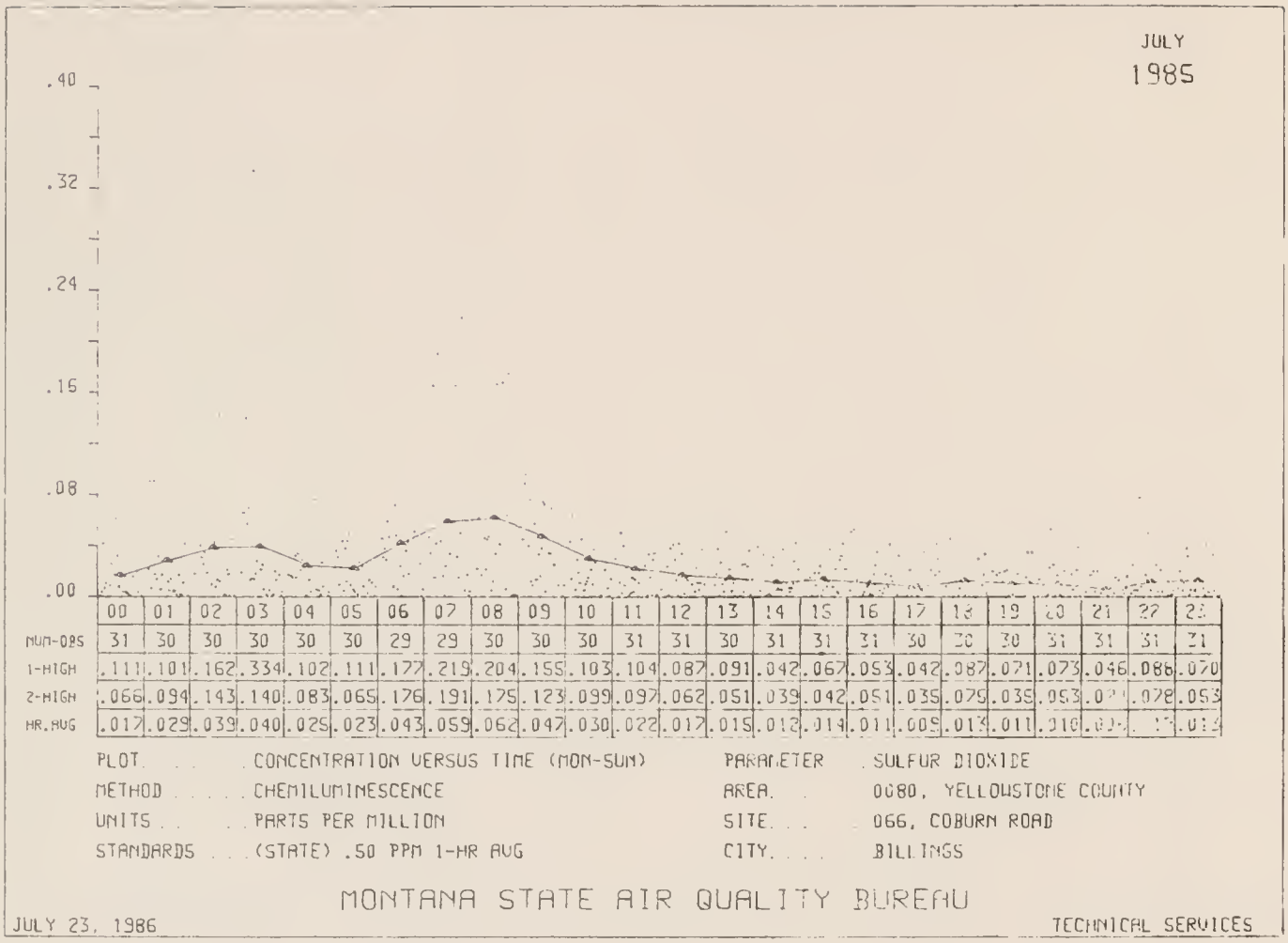
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	22	22	22	22	22	22	22	22	21	22	22	21	22	22	20	20	19	22	22	22	22	22	22	22
1-HIGH	.155	.129	.200	.253	.236	.181	.180	.110	.189	.224	.209	.122	.194	.247	.196	.133	.096	.091	.048	.074	.190	.112	.150	.358
2-HIGH	.105	.105	.181	.193	.202	.156	.123	.093	.108	.218	.175	.093	.070	.097	.065	.083	.061	.043	.044	.042	.031	.061	.115	.126
HR.AVG	.033	.025	.037	.045	.050	.033	.041	.035	.041	.055	.053	.040	.028	.023	.021	.018	.014	.008	.008	.009	.016	.015	.023	.039

PLOT	CONCENTRATION VERSUS TIME (MON-SUN)	PARAMETER	SULFUR DIOXIDE
METHOD	CHEMILUMINESCENCE	AREA	0080, YELLOWSTONE COUNTY
UNITS	PARTS PER MILLION	SITE	066, COBURN ROAD
STANDARDS	(STATE) .50 PPM 1-HR AVG	CITY	BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

FIGURE 56



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	30	30	30	30	30	29	29	30	30	30	31	31	30	31	31	31	30	30	30	31	31	31	31
1-HIGH	.111	.101	.162	.334	.102	.111	.177	.219	.204	.155	.103	.104	.087	.091	.042	.067	.053	.042	.087	.071	.073	.046	.086	.070
2-HIGH	.066	.094	.143	.140	.083	.065	.176	.191	.175	.123	.099	.097	.062	.051	.039	.042	.051	.035	.079	.039	.053	.02[illegible]	.078	.053
HR.AVG	.017	.029	.039	.040	.025	.023	.043	.059	.062	.047	.030	.022	.017	.015	.013	.014	.011	.009	.013	.011	.010	.00[illegible]	[illegible]	.013

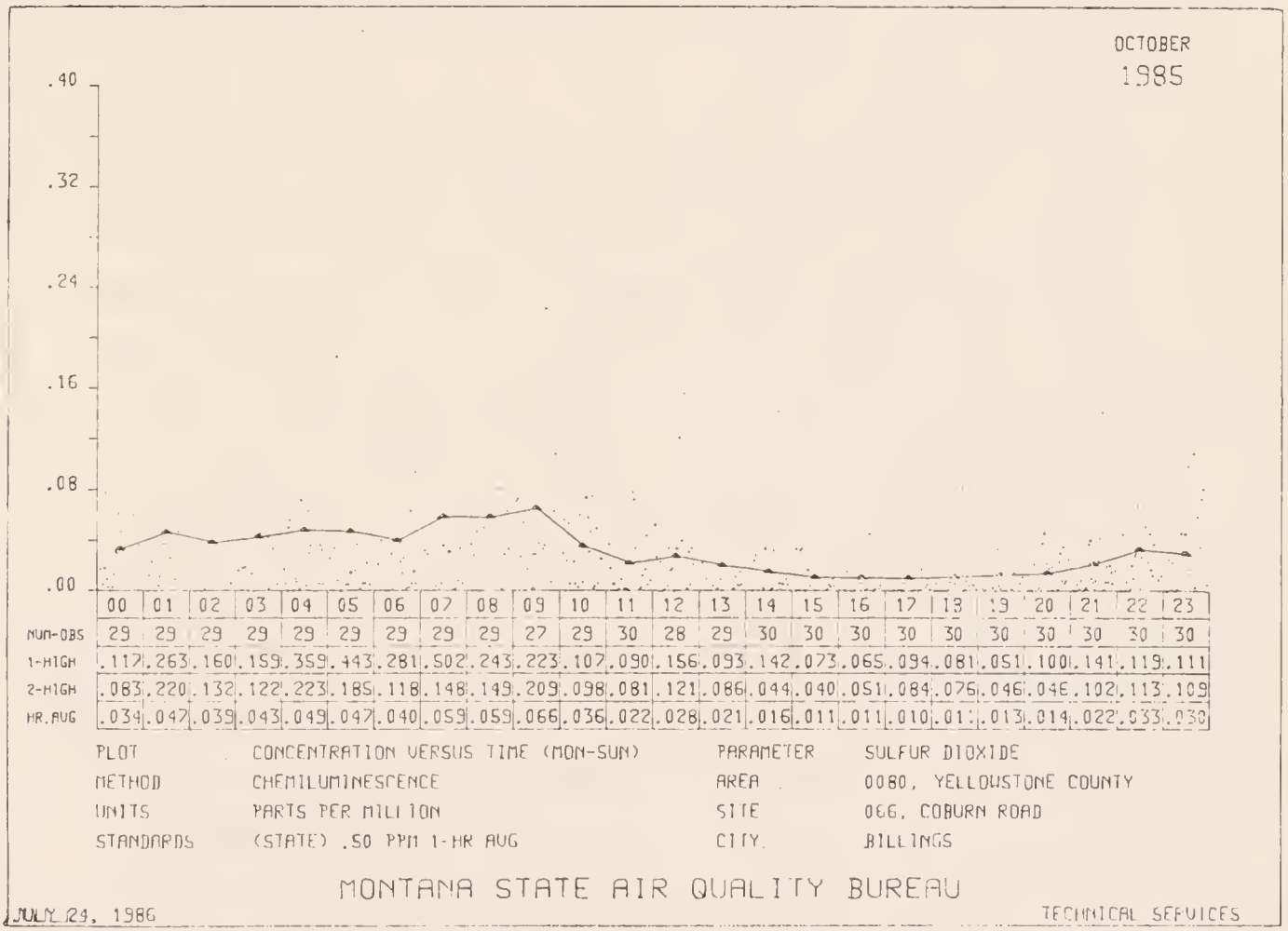
PLOT . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . CHEMILUMINESCENCE
UNITS . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . SULFUR DIOXIDE
AREA. . . 0080, YELLOWSTONE COUNTY
SITE. . . . 066, COBURN ROAD
CITY. . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

FIGURE 57



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	29	29	29	29	29	29	29	29	29	27	29	30	28	29	30	30	30	30	30	30	30	30	30	30
1-HIGH	.117	.263	.160	.159	.359	.443	.281	.502	.243	.223	.107	.090	.156	.093	.142	.073	.065	.094	.081	.051	.100	.141	.119	.111
2-HIGH	.083	.220	.132	.122	.223	.185	.118	.148	.149	.209	.098	.081	.121	.086	.044	.040	.051	.084	.076	.046	.048	.102	.113	.109
HR.AVG	.034	.047	.039	.043	.049	.047	.040	.059	.059	.066	.036	.022	.028	.021	.016	.011	.011	.010	.011	.013	.014	.022	.033	.030

PLOT	CONCENTRATION VERSUS TIME (MON-SUN)	PARAMETER	SULFUR DIOXIDE
METHOD	CHEMILUMINESCENCE	AREA	0080, YELLOWSTONE COUNTY
UNITS	PARTS PER MILLION	SITE	066, COBURN ROAD
STANDARDS	(STATE) .50 PPM 1-HR AVG	CITY	BILLINGS

MONTANA STATE AIR QUALITY BUREAU

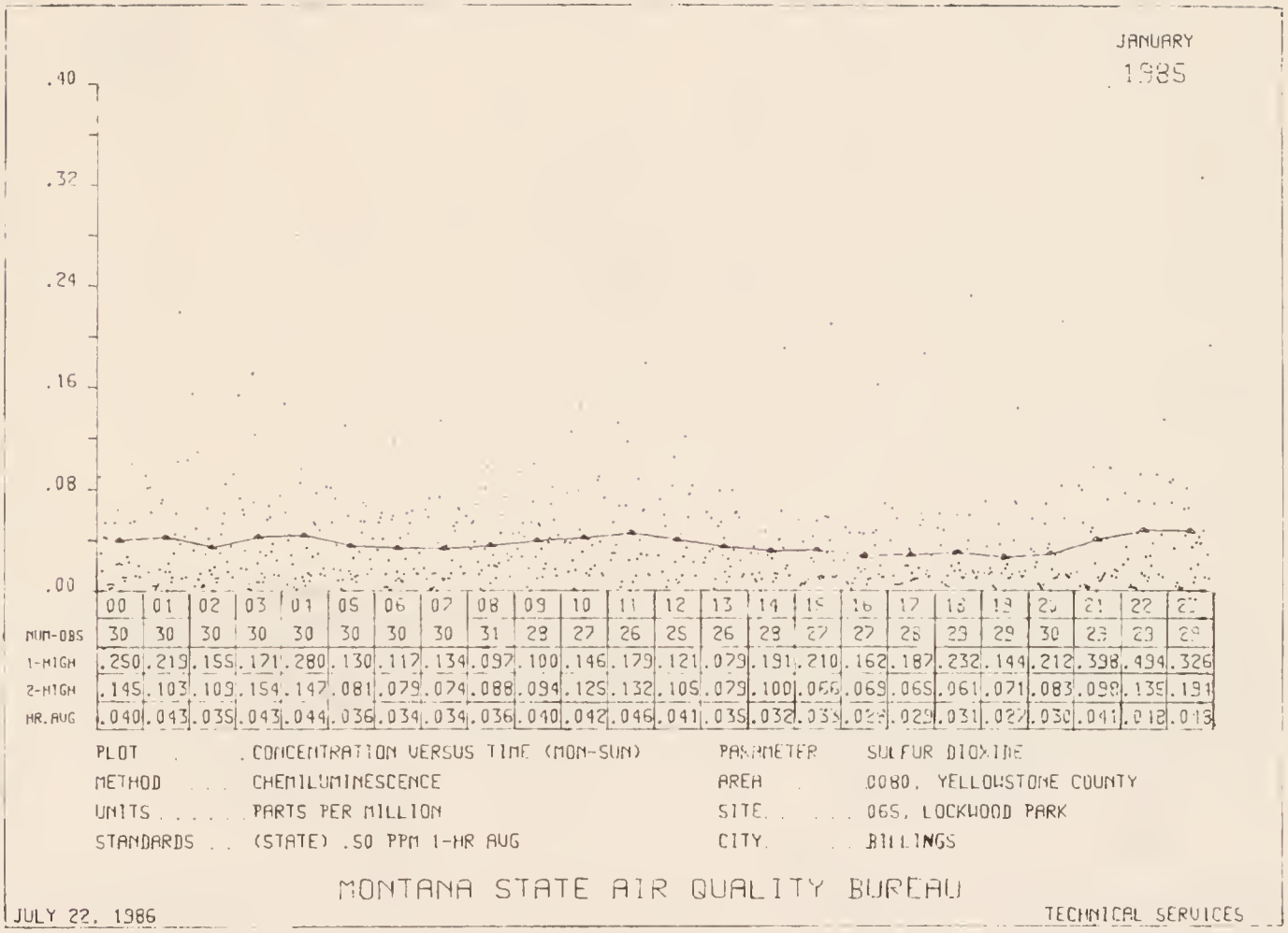
JULY 24, 1986 TECHNICAL SERVICES

11. Since Coburn Road consistently records high sulfur dioxide concentrations, the department intends to continue to monitor sulfur dioxide at this location. In addition, the site will be the key site in determining the amount of sulfur dioxide control necessary at each plant.

12. The Lockwood Park site is located in the northwest corner of the Lockwood Little League Park. The site is near the center of the Lockwood area and approximately 0.5 mile south-southeast of the Exxon Refinery and the Montana Sulphur and Chemical Company. The Billings area sulfur dioxide sources lie 3.5 miles to the southwest over the ridge that the Coburn Road site lies on. Emissions from the Billings sources must either rise over the ridge or go north around the ridge and west through a constriction in the Yellowstone Valley. Winds at the Lockwood Park site averaged 2.4 meters per second in 1982. The predominant wind direction is from the south to the west-southwest with a secondary predominance from the northeast.

13. Sulfur dioxide concentrations at the Lockwood Park site violated the Montana twenty-four hour standard during 1985. Table 26 summarizes the sulfur dioxide concentrations at Lockwood Park. The annual averag was above the Montana standard but insufficient data was gathered to establish a valid annual average. Figures 58, 59, 60 and 61 display diurnal plots of sulfur dioxide concentrations at the Lockwood Park site for January, March, July and October, 1985. Similar to the Coburn Road site, the peak concentrations occur during the morning, usually between 7:00 a.m. and 12:00 noon. Also similar to the Coburn Road site, the January hourly readings were more erratic than March, July or

FIGURE 58



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	30	30	30	30	30	30	30	30	31	28	27	26	25	26	28	27	27	28	29	29	30	28	28	29
1-HIGH	.250	.219	.155	.171	.280	.130	.112	.134	.097	.100	.146	.179	.121	.079	.191	.210	.162	.187	.232	.144	.212	.398	.494	.326
2-HIGH	.145	.103	.109	.154	.147	.081	.079	.074	.088	.094	.125	.132	.105	.079	.100	.066	.069	.065	.061	.071	.083	.099	.135	.191
HR.AVG	.040	.043	.035	.043	.044	.036	.034	.034	.036	.040	.042	.046	.041	.035	.032	.035	.029	.029	.031	.027	.030	.041	.012	.013

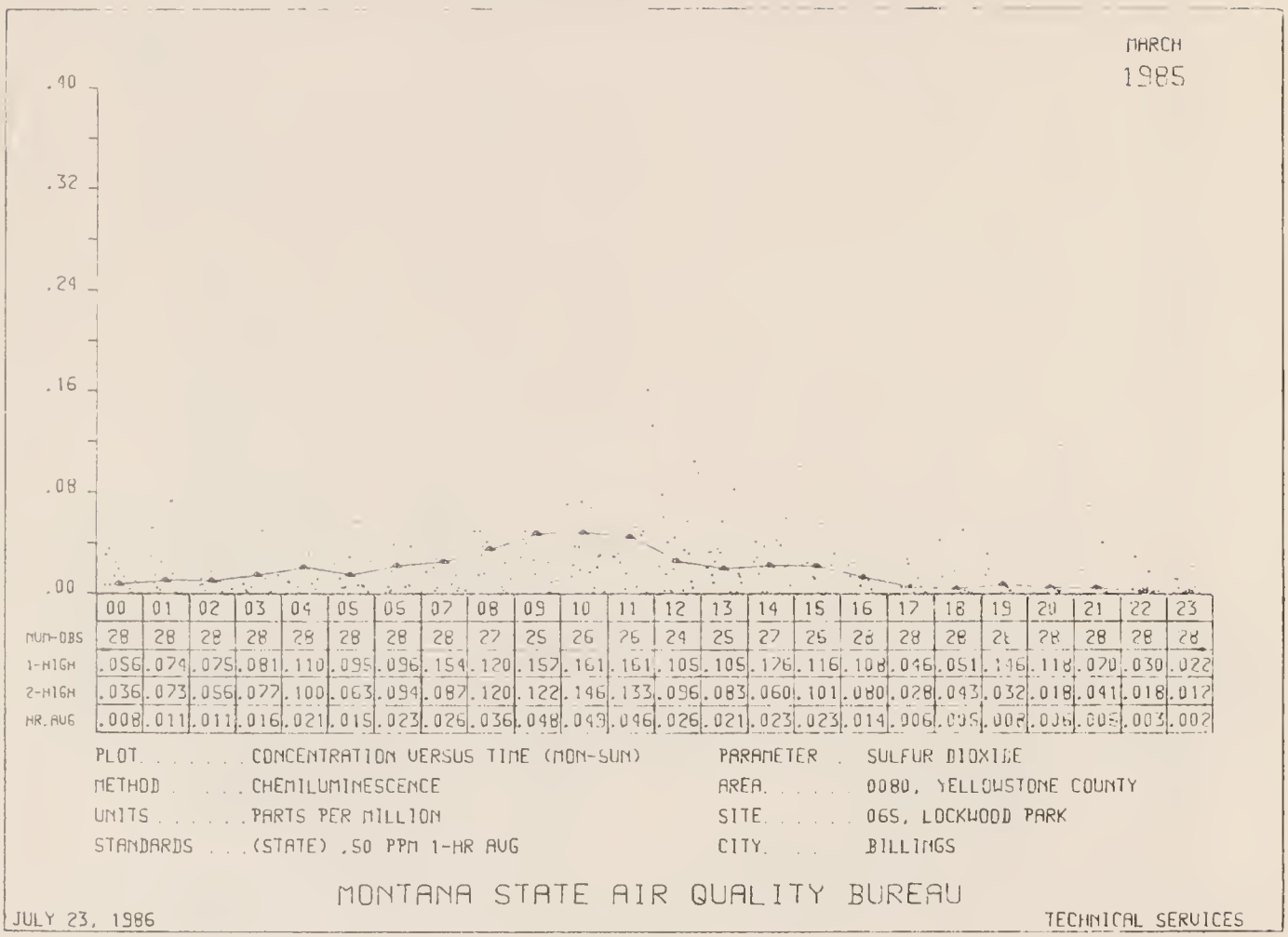
PLOT . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . (STATE) .50 PPM 1-HR AVG

PARAMETER . . SULFUR DIOXIDE
AREA . . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 065, LOCKWOOD PARK
CITY. . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 22, 1986 TECHNICAL SERVICES

FIGURE 59



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	28	28	28	28	28	28	28	28	27	25	26	26	24	25	27	25	28	28	28	28	28	28	28	28
1-HIGH	.056	.074	.075	.081	.110	.095	.096	.154	.120	.157	.161	.161	.105	.105	.176	.116	.108	.046	.051	.146	.118	.070	.030	.022
2-HIGH	.036	.073	.056	.077	.100	.063	.094	.087	.120	.122	.146	.133	.096	.083	.060	.101	.080	.028	.043	.032	.018	.041	.018	.012
HR.AVG	.008	.011	.011	.016	.021	.015	.023	.026	.036	.048	.049	.046	.026	.021	.023	.023	.014	.006	.005	.008	.006	.005	.003	.002

PLOT . . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . SULFUR DIOXIDE
AREA. . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 065, LOCKWOOD PARK
CITY. . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

FIGURE 60

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	31	31	31	31	31	31	30	30	30	31	30	30	30	30	30	29	30	30	31	31	31	31	31
1-HIGH	.130	.081	.049	.097	.101	.084	.161	.155	.291	.332	.139	.100	.140	.156	.151	.150	.123	.168	.213	.120	.155	.035	.204	.112
2-HIGH	.056	.067	.046	.060	.054	.068	.094	.139	.124	.203	.113	.099	.097	.128	.048	.033	.099	.109	.138	.089	.141	.023	.047	.058
HR.AVG	.015	.013	.014	.013	.017	.025	.038	.058	.057	.051	.035	.035	.027	.020	.013	.012	.013	.018	.020	.011	.018	.006	.014	.012

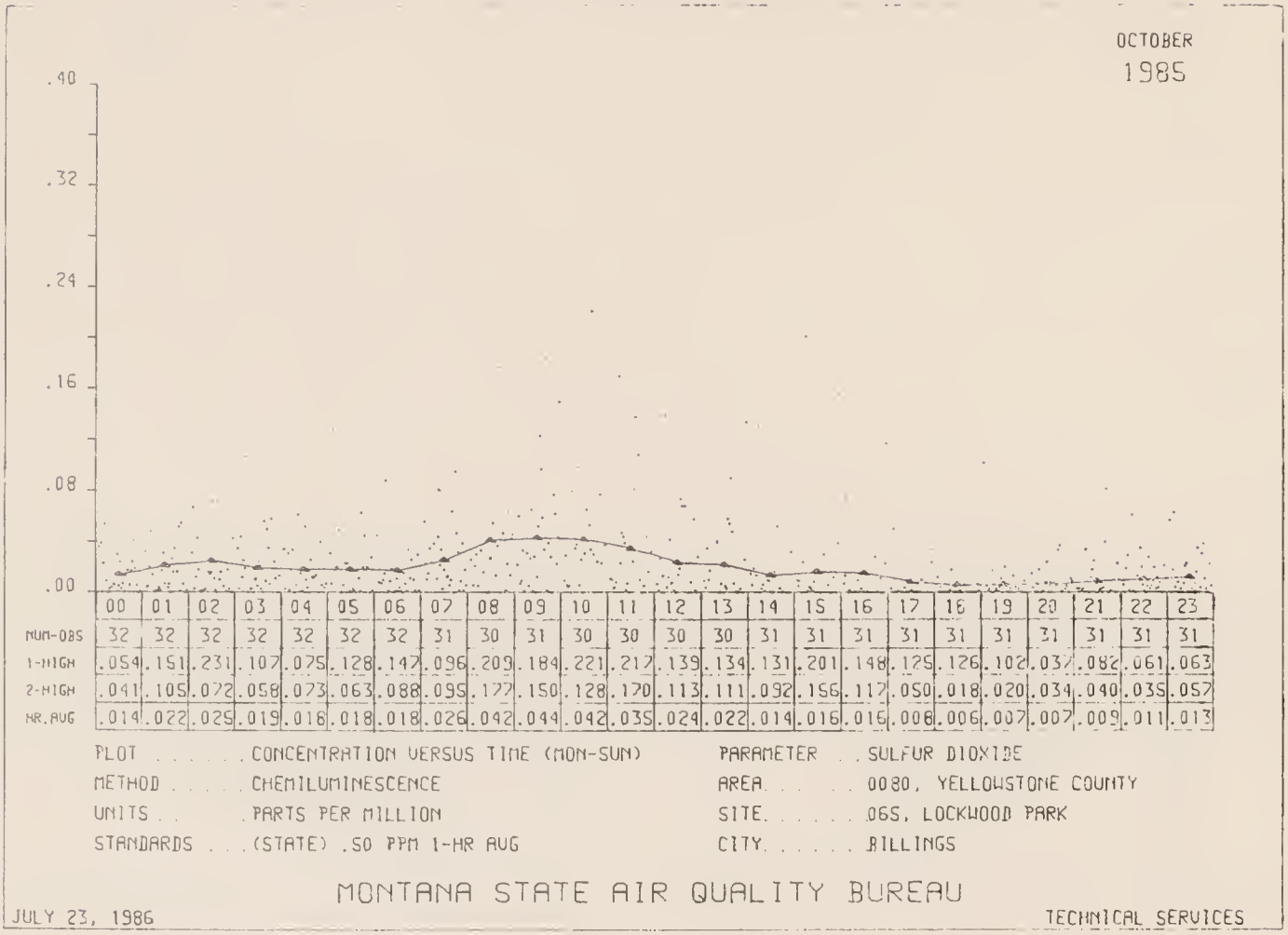
PLOT. . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . CHEMILUMINESCENCE
UNITS . . . . PARTS PER MILLION
STANDARDS . (STATE) .50 PPM 1-HR AVG

PARAMETER . SULFUR DIOXIDE
AREA 0080, YELLOWSTONE COUNTY
SITE. . 06S, LOCKWOOD PARK
CITY BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

FIGURE 61



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	32	32	32	32	32	32	32	31	30	31	30	30	30	30	31	31	31	31	31	31	31	31	31	31
1-HIGH	.054	.151	.231	.107	.075	.128	.147	.096	.209	.184	.221	.217	.139	.134	.131	.201	.148	.125	.126	.102	.037	.082	.061	.063
2-HIGH	.041	.105	.072	.058	.073	.063	.088	.095	.177	.150	.128	.170	.113	.111	.092	.156	.117	.050	.018	.020	.034	.040	.035	.057
HR.AVG	.014	.022	.029	.019	.016	.018	.018	.026	.042	.044	.042	.035	.024	.022	.014	.016	.016	.008	.006	.007	.007	.009	.011	.013

PLOT . . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . . SULFUR DIOXIDE
AREA . . . . . 0080, YELLOWSTONE COUNTY
SITE . . . . . 06S, LOCKWOOD PARK
CITY . . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 23, 1986 TECHNICAL SERVICES

October readings. The department suspects that during January, the sun's angle is so low that surface heating is insufficient to eliminate temperature inversions. As mentioned earlier, during inversion breakups, Billings often records high concentrations. During other times of the year, inversion breakups occur during the morning and result in high concentrations.

14. The department plans to continue to operate the Lockwood Park NAMS site. The relatively high sulfur dioxide readings and its location near the center of population for Lockwood make the site essential. However, the Parks Department is in the process of building a new access road within the park and, therefore, the department moved the site approximately 100 yards southeast of the existing site. The shelter was moved during August, 1986.

15. The North Johnson Lane site was located in a field one mile northeast of the Exxon refinery and the Montana Sulphur and Chemical Company. It was also 4.5 miles northeast of the Billings area sulfur dioxide sources. The immediate area around the site was undeveloped with the exception of an asphalt batch plant 200 yards to the north.
Winds at North Johnson Lane are predominantly from the southwest and to a lesser extent from the northeast. The average wind speed during 1982 was 2.8 meters per second. This is slightly higher than at Lockwood Park, but lower than Coburn Road.

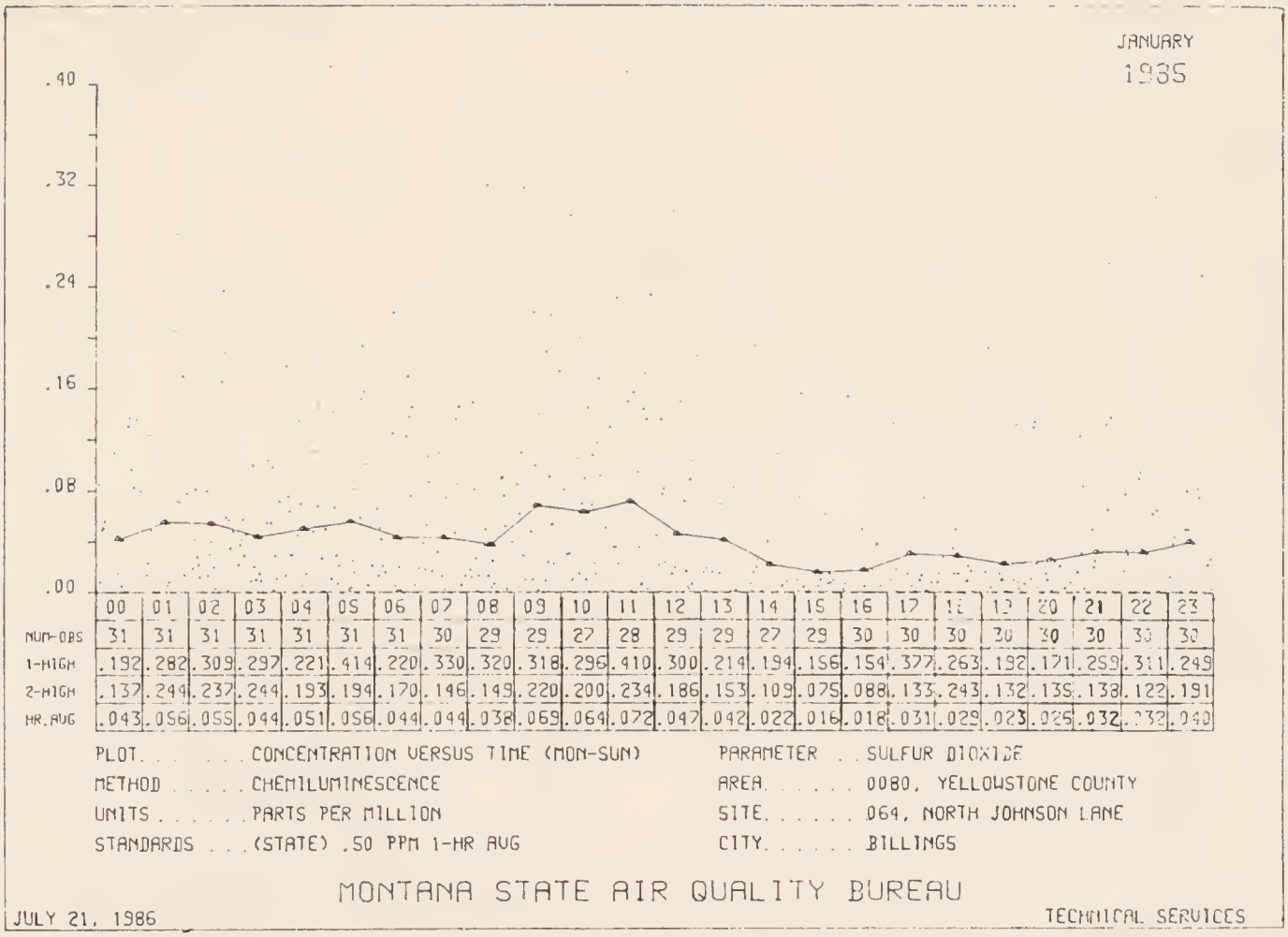
16. During 1985, the North Johnson Lane site registered seven sulfur dioxide readings in excess of the Montana twenty-four hour standard (see Tables 26 and 27). Sulfur dioxide concentrations at the North Johnson Lane site complied with all other state and federal standards.

Figures 62, 63, 64 and 65 show the diurnal distributions of sulfur dioxide concentrations at the North Johnson Lane site for January, March, July and October, 1985. As with the other sites, the highest concentrations occur in the morning from 8:00 a.m. to noon. The January plot was erratic and, therefore, also similar to the other sites.

17. The department shut down the North Johnson Lane site during June, 1986, and intends to move the site to Laurel during the fall of 1986. The department decided to shut down this site due to the cost of the land lease and in order to establish a sulfur dioxide network with a wider geographical coverage. The current network consists of three sites all surrounding the Lockwood area while the major sulfur dioxide emitters are located in three general areas: Lockwood, the southeast side of Billings and near Laurel.

18. The department plans to re-establish a sulfur dioxide site in Laurel during September or October, 1986. The specific area being considered is just east of the CENEX refinery in the vicinity of the long abandoned Farm site. Monitoring was eliminated at the Farm site in June, 1980, and throughout the Laurel area in September, 1982. During 1980, the CENEX refinery raised several of their stacks and the department decided to move the Farm site farther from the refinery. The department believed that by raising the stack heights, CENEX would effectively move the area of maximum sulfur dioxide concentration farther from the refinery. This site was known as the New Farm site and was operated in conjunction with a second Laurel site called the BN site as part of the "Billings Sulfur Dioxide Study." When the air

FIGURE 62



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	31	31	31	31	31	31	30	29	29	27	28	29	29	27	29	30	30	30	30	30	30	30	30
1-HIGH	.192	.282	.309	.297	.221	.414	.220	.330	.320	.318	.296	.410	.300	.214	.194	.156	.154	.327	.263	.192	.171	.259	.311	.249
2-HIGH	.137	.244	.237	.244	.193	.194	.170	.146	.149	.220	.200	.234	.186	.153	.109	.075	.088	.133	.243	.132	.135	.138	.122	.191
HR.AVG	.043	.056	.055	.044	.051	.056	.044	.044	.038	.069	.064	.072	.047	.042	.022	.016	.018	.031	.029	.023	.026	.032	.032	.040

PLOT. . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . . SULFUR DIOXIDE
AREA. . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 064, NORTH JOHNSON LANE
CITY. . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 21, 1986

TECHNICAL SERVICES

FIGURE 63

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	29	29	29	29	29	29	29	29	29	28	26	27	28	27	27	28	27	28	28	28	28	28	28	28
1-HIGH	.084	.098	.214	.083	.130	.132	.113	.276	.351	.216	.291	.156	.131	.088	.052	.036	.042	.045	.023	.020	.041	.014	.034	.018
2-HIGH	.046	.047	.073	.069	.120	.096	.112	.170	.297	.193	.203	.124	.111	.086	.046	.030	.035	.030	.018	.007	.010	.006	.023	.010
HR.AVG	.007	.011	.017	.014	.016	.016	.019	.033	.055	.046	.060	.034	.025	.016	.009	.006	.005	.005	.004	.003	.003	.001	.003	.002

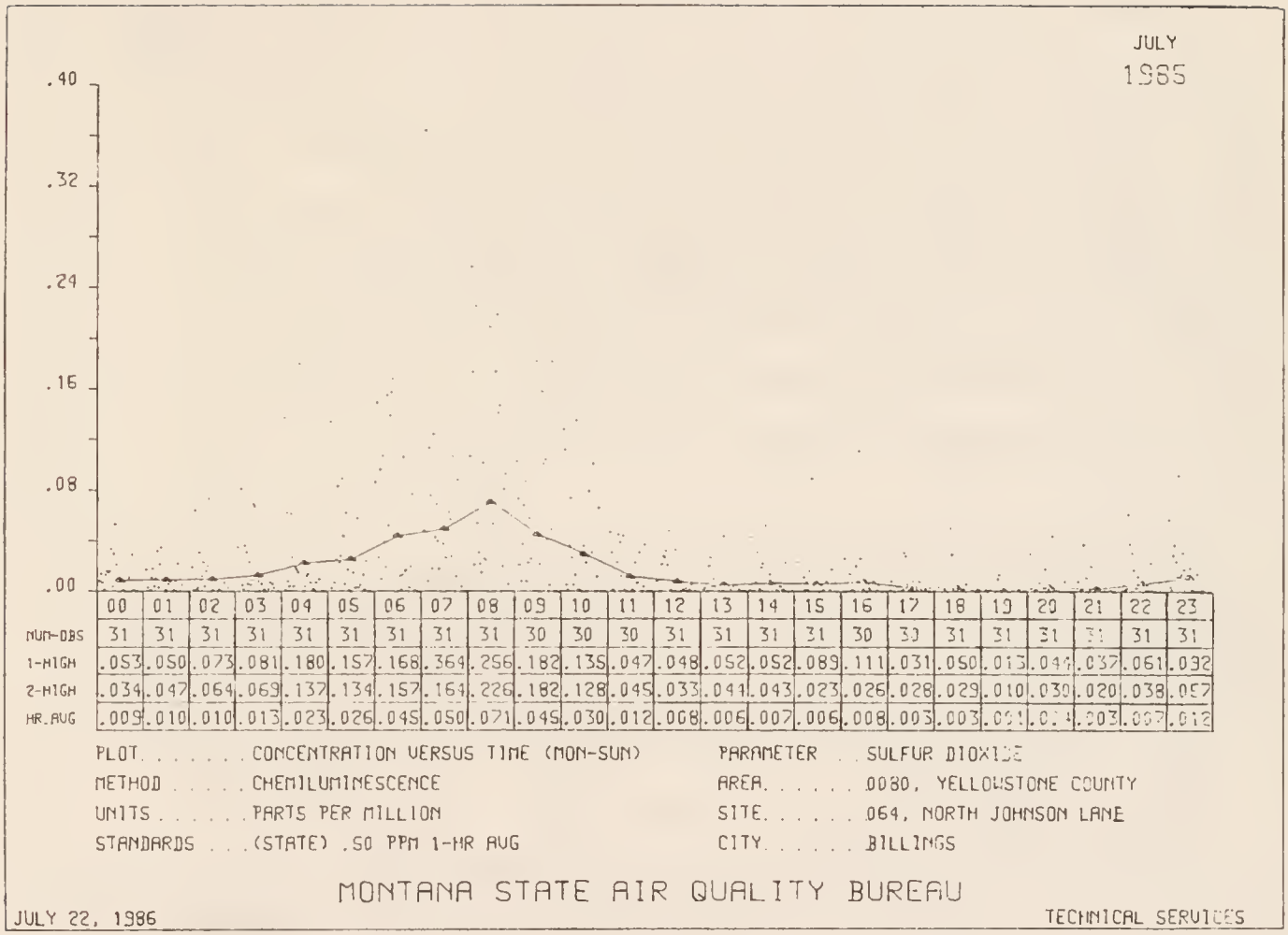
PLOT. . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . SULFUR DIOXIDE
AREA. . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 064, NORTH JOHNSON LANE
CITY . . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 21, 1986 TECHNICAL SERVICES

FIGURE 64



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	31	31	31	31	31	31	31	31	30	30	30	31	31	31	31	30	30	31	31	31	31	31	31
1-HIGH	.053	.050	.073	.081	.180	.157	.168	.364	.256	.182	.135	.047	.048	.052	.052	.089	.111	.031	.050	.013	.044	.037	.061	.032
2-HIGH	.034	.047	.064	.069	.137	.134	.157	.164	.226	.182	.128	.045	.033	.041	.043	.023	.026	.028	.029	.010	.030	.020	.038	.057
HR.AVG	.009	.010	.010	.013	.023	.026	.045	.050	.071	.045	.030	.012	.008	.006	.007	.006	.008	.003	.003	.001	.014	.003	.007	.012

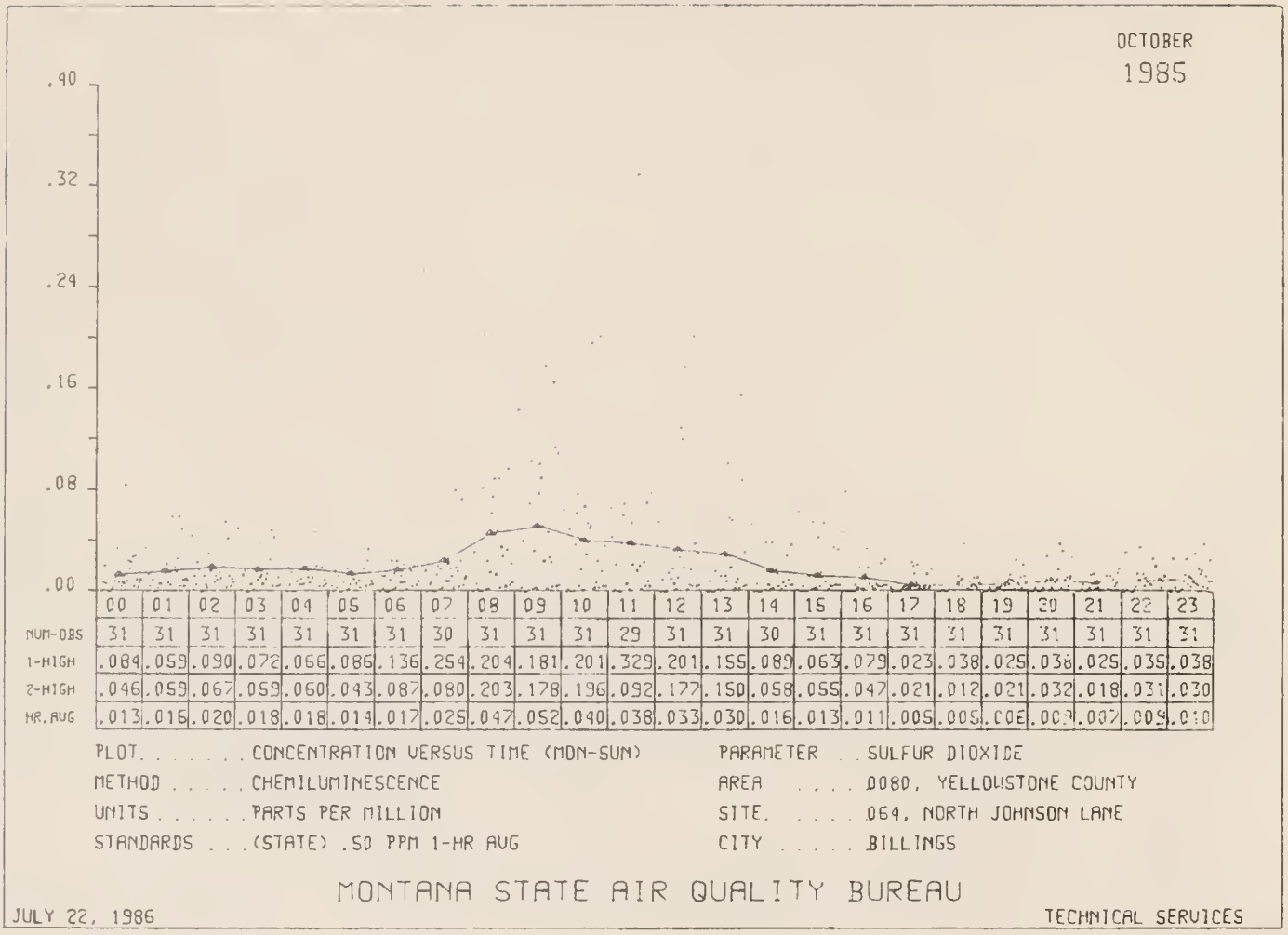
PLOT . . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . . SULFUR DIOXIDE
AREA. . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 064, NORTH JOHNSON LANE
CITY. . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

JULY 22, 1986 TECHNICAL SERVICES

FIGURE 65



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	31	31	31	31	31	31	31	30	31	31	31	29	31	31	30	31	31	31	31	31	31	31	31	31
1-HIGH	.084	.059	.090	.072	.066	.086	.136	.254	.204	.181	.201	.329	.201	.155	.089	.063	.079	.023	.038	.025	.036	.025	.035	.038
2-HIGH	.046	.059	.067	.059	.060	.043	.087	.080	.203	.178	.196	.092	.177	.150	.058	.055	.047	.021	.012	.021	.032	.018	.031	.030
HR.AVG	.013	.016	.020	.018	.018	.014	.017	.025	.047	.052	.040	.038	.033	.030	.016	.013	.011	.005	.005	.00E	.00?	.007	.009	.010

PLOT. . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . CHEMILUMINESCENCE
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (STATE) .50 PPM 1-HR AVG

PARAMETER . . SULFUR DIOXIDE
AREA . . . . 0080, YELLOWSTONE COUNTY
SITE. . . . . 064, NORTH JOHNSON LANE
CITY . . . . . BILLINGS

MONTANA STATE AIR QUALITY BUREAU

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monitoring portion of the study ended in October, 1982, both Laurel sites were shut down. The department chose to shut down the Laurel sites since sulfur dioxide levels were higher in the Billings and Lockwood areas and because the department's Billings operator had insufficient time to operate all the existing monitoring sites.

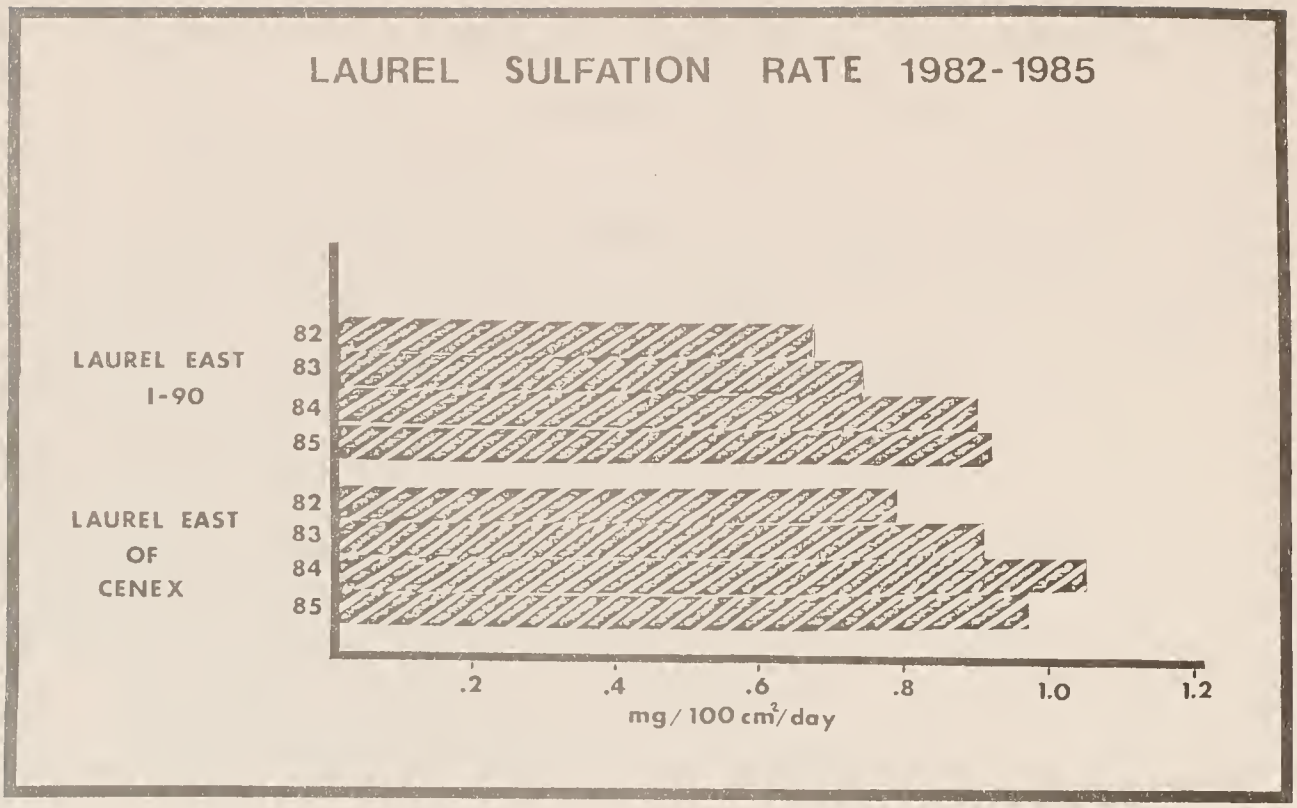
19. The department reviewed the sulfation rate data gathered in the Laurel area by the Yellowstone County Air Pollution Control Agency, and determined that the levels have been increasing over the past few years. The highest sulfation rates in the Laurel area during the last few years have been recorded at two locations near the original Farm site. Since 1982, the sulfation rate has increased 38 percent at the Laurel East I-90 site and 23 percent at the Farm East of CENEX site (Figure 66). The department believes that the CENEX sulfur plant is largely responsible for the apparent increase in sulfur dioxide concentrations.

20. The department intends to monitor within the vicinity of the original Farm site for at least one year. The primary objectives of monitoring at this location are to re-establish monitoring in the Laurel area and to determine if sulfur dioxide levels are increasing.

21. The department also intends to open a new monitoring site at the Billings Air Quality Office provided the office will meet siting criteria. If the site is not acceptable, the department will look for a sampling location in an area just south of the office.

22. The primary purpose of this site will be to monitor sulfur dioxide within the heart of Billings. The data from the site will also be very useful in calibrating the department's mathematical source apportionment model. When the model was originally developed, the data from the

FIGURE 66



now shutdown Taft School site served this function. In addition, a monitoring site in this area will be convenient to service and, therefore, will save on the operator's time.

23. The department has measured sulfur dioxide levels in the Billings-Laurel area for almost ten years. In order to place the Billings sulfur dioxide concentrations into perspective, the department decided to compare the Billings concentrations with concentrations in other parts of the nation. The department obtained a copy of an EPA report entitled "National Air Quality and Emission Trends Report, 1984." This report provides the annual average and second highest twenty-four hour concentrations recorded at any monitoring site within each standard

metropolitan statistical area (SMSA) with a population of 500,000 or more. Depending on the year, data was available for between 70 and 80 SMSAs.

The results of the comparison are shown in Table 28. In 1984, Billings recorded sulfur dioxide concentrations which were higher than 94 percent of the SMSAs in regard to the second highest twenty-four hour average and 98 percent of the SMSAs for the annual average. The fact that Billings has sulfur dioxide levels which are higher than cities such as Cleveland, Detroit, Buffalo, Birmingham and Los Angeles underscores the magnitude of the problem.

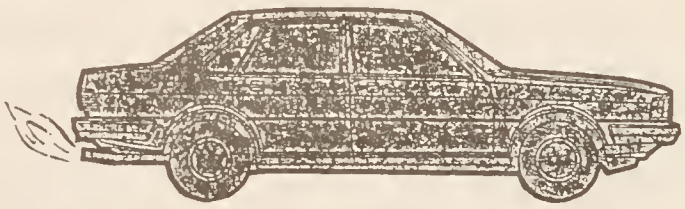
TABLE 28

COMPARISON OF BILLINGS SULFUR DIOXIDE CONCENTRATIONS TO THE REST OF THE NATION

	2nd Highest 24-hour			Highest Annual Average		
Year	No. of Cities With Data	No. of Cities Cleaner than Billings	% of Cities Cleaner than Billings	No. of Cities With Data	No. of Cities Cleaner than Billings	% of Cities Cleaner than Billings
1982	79	74	93.6	75	74	98.7
1983	77	75	97.4	73	72	98.6
1984	74	70	94.6	70	69	98.6

24. The department and Yellowstone County also intend to temporarily enlarge the Billings/Laurel/Lockwood sulfation plate network to gather information concerning the geographical distribution of sulfur dioxide concentrations. The proposed network was described in detail in the prior section of this report entitled "Sulfation Rate."

Carbon Monoxide



Automobile exhaust is the principal source of carbon monoxide emissions, although some industries also emit carbon monoxide, and agricultural and forestry burning are contributors in some areas. In some western Montana valleys, residential wood burning is an important source.

In 1985, the department, with the cooperation of the various county agencies, monitored carbon monoxide at one location each in Missoula, Great Falls and Billings.

Billings

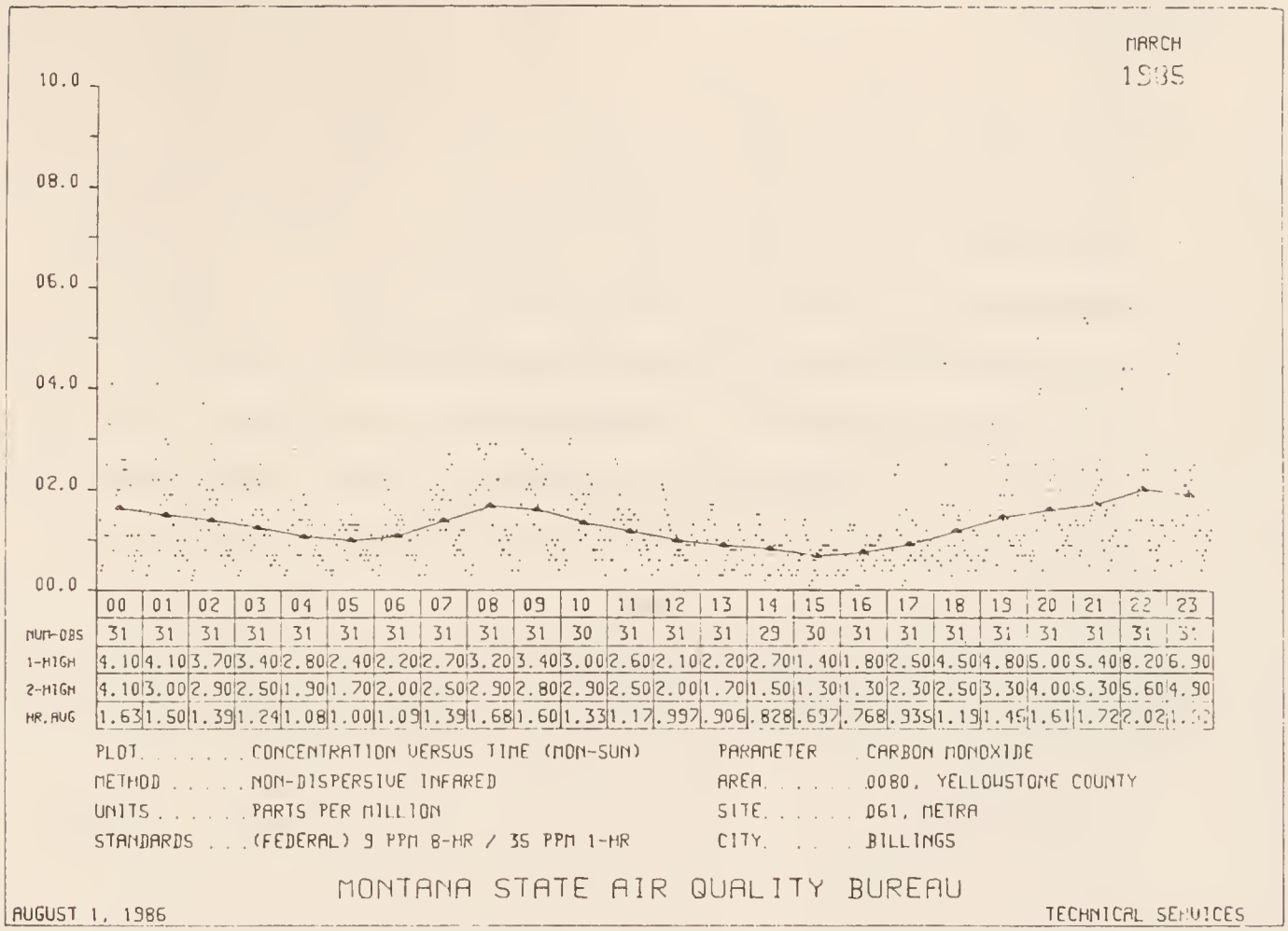
1. The Billings downtown area was designated nonattainment for carbon monoxide due to high readings in the past. These readings were taken at the 27th and Montana site but this site had to be removed due to building construction. Concurrent with the site shutdown, a modeling study was conducted to determine which Billings intersections were the most likely to violate carbon monoxide standards. The study identified the area along Exposition Drive near the Yellowstone County Fairgrounds

as having the highest potential to exceed the standards. Based on these results, a new site was established at the Billings Metra-Fairgrounds complex (see Figure 39).

2. In 1985, an eight-hour high of 4.5 ppm was recorded (see Table 29). Figure 67 shows the diurnal pattern of carbon monoxide concentrations at the Fairgrounds site for March, 1985. This plot displays the typical 8:00 a.m. and 5:00 p.m. carbon monoxide peaks associated with traffic. The levels remain high throughout the late night period, which may be attributable to traffic leaving the Metra after evening events, or general areawide carbon monoxide levels.

3. The Fairgrounds site is located some distance from Exposition Drive due to siting problems. Therefore, the relatively low carbon monoxide concentrations observed were expected. The department is in the process of analyzing the data from this site to evaluate the compliance status of the Exposition Drive area. The improvements to Exposition Drive were completed in November, 1983. The department and Yellowstone County experienced a considerable amount of problems with the monitoring equipment during the winter of 1983-1984 and winter is the time when high carbon monoxide levels occur in Montana. However, relatively good data recovery was achieved during the winters of 1984-1985 and 1985-1986. EPA requires two years of ambient data as evidence indicating compliance with ambient standards before the area can be redesignated to attainment. Since the department's preliminary analysis showed that carbon monoxide levels are well below the standards and since two and one-half years of data have been collected following the completion of the reconstruction project, Yellowstone

FIGURE 67



County shut down the Metra carbon monoxide site on April 1, 1986. The department is developing a redesignation request for EPA to redesignate the area attainment for carbon monoxide.

TABLE 29
MONTANA CARBON MONOXIDE DATA FOR 1985
(ppm)

City	Site	Max. 1-hr. Avg.	2nd Max. 1-hr. Avg.	Max. 8-hr. Avg.	2nd Max. 8-hr. Avg.
Billings	Metra-Fairgrounds	10.5	9.5	4.5	4.4
Great Falls	Pardis Clinic	11.1	10.8	8.2	6.2
Missoula	Boyd Park	14.6	12.6	11.1	9.9

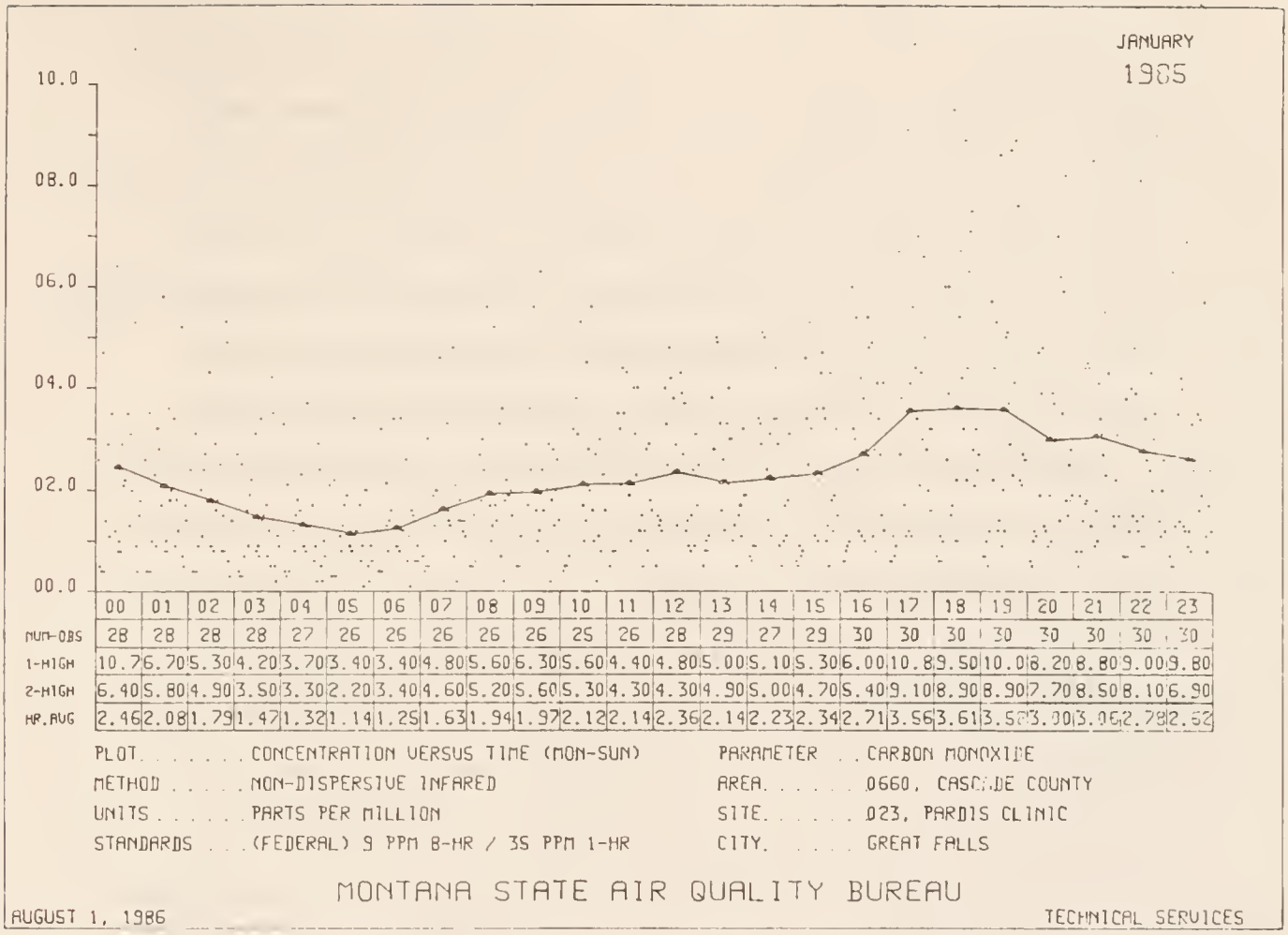
Great Falls

1. In 1979, carbon monoxide sampling was conducted in Great Falls at the Midas Muffler Shop on 10th Avenue South and 9th Street. This site was used to designate the area nonattainment. Due to a leasing problem, the site had to be relocated a short distance away on 10th Avenue South at the Great Falls Federal Savings and Loan Building. In accordance with the 1983 Network Review, the site was moved again to the Pardis Clinic site (see Figure 36). The department anticipated higher concentrations at this site because it is located at a lower elevation nearer the river and the traffic volume on 10th Avenue South is higher at this location.

2. During 1985, carbon monoxide levels at the Pardis Clinic site were in compliance with all state and federal ambient air quality standards (see Table 29). Figure 68 shows the diurnal distribution of carbon monoxide concentrations at the Pardis Clinic site during January, 1985. The plot shows increasing concentrations from 8:00 a.m. to 7:00 p.m. and decreasing concentrations throughout the night. Although distinct peaks at 8:00 a.m. and 5:00 p.m. are not present as in past years, the high concentrations occur during the day when tailpipe emissions are the major source of carbon monoxide in Great Falls.

3. In the past the department assumed that traffic on 10th Avenue South was responsible for carbon monoxide violations at the Great Falls Federal and the Midas Muffler Shop sites. However, in 1982, the department performed an analysis of carbon monoxide concentrations versus wind speed and direction and uncovered some startling results.

FIGURE 68



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	28	28	28	28	27	26	26	26	26	26	25	26	28	29	27	29	30	30	30	30	30	30	30	30
1-HIGH	10.7	6.70	5.30	4.20	3.70	3.40	3.40	4.80	5.60	6.30	5.60	4.40	4.80	5.00	5.10	5.30	6.00	10.8	9.50	10.0	8.20	8.80	9.00	9.80
2-HIGH	6.40	5.80	4.90	3.50	3.30	2.20	3.40	4.60	5.20	5.60	5.30	4.30	4.30	4.90	5.00	4.70	5.40	9.10	8.90	8.90	7.70	8.50	8.10	6.90
HR.AVG	2.46	2.08	1.79	1.47	1.32	1.14	1.25	1.63	1.94	1.97	2.12	2.14	2.36	2.14	2.23	2.34	2.71	3.56	3.61	3.58	3.30	3.06	2.78	2.62

PLOT. . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . NON-DISPERSIVE INFARED
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (FEDERAL) 9 PPM 8-HR / 35 PPM 1-HR
PARAMETER . . CARBON MONOXIDE
AREA. . . . . 0660, CASCADE COUNTY
SITE. . . . . 023, PARDIS CLINIC
CITY. . . . . GREAT FALLS

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Unexpectedly, the highest carbon monoxide concentrations occurred with northeast winds. This wind direction would carry carbon monoxide emissions from 10th Avenue South away from the monitor at both the old Great Falls Federal and Midas Muffler Shop sites. Further examination showed that quite often the higher concentrations were associated with a shallow mass of cold air drifting in from the northeast. In fact, during some episodes, winds at Malmstrom Air Force Base, and presumably in Great Falls, were northeast while winds at the Great Falls Airport were still southwest. However, winds at the airport usually shifted

northeast during the later stages of the episodes. Since these cold air masses are shallow and moving in from the northeast, winds at the air base (one mile east of Great Falls and at a similar elevation) would shift to the northeast first, followed by Great Falls and finally the airport, which is one mile southwest of the city and 300 feet higher. In light of this information, the department now suspects that the high carbon monoxide concentrations are caused by citywide emissions which are being trapped in the shallow mass of cold air.

4. In 1982, PEDCo Inc. was hired by the Great Falls City-County Planning Board to perform a dispersion model of the carbon monoxide emissions in the vicinity of 10th Avenue South. The results of the model indicate that the attainment status is questionable at several intersections along 10th Avenue South. PEDCo Inc. pointed out that the average speed of vehicles on 10th Avenue South is critical and that a five mile per hour increase in speed could result in compliance. The department originally believed that the completion of the additional lanes on the 10th Avenue South bridge and a traffic light synchronization project would sufficiently increase the average vehicle speed and solve the problem. In light of paragraph 3 above, the department was forced to consider new citywide control strategies.

5. In addition, during 1984, the department discovered that the Montana Refining Company (formerly Phillips Petroleum) had not modified their plant to obtain an 8000 ton per year reduction in carbon monoxide. The department included this emission reduction in the original SIP submittal and Phillips Petroleum actually obtained an air quality permit to make the modifications. Unfortunately, the permit was not

legally tied to the SIP and Phillips decided not to make the modifications. However, Phillips did install a catalyst promoter which reduced carbon monoxide 5500 tons per year and an FCC preheater which resulted in an additional 1500 tons per year reduction. In 1985, the department negotiated with Montana Refining Company to issue a permit legally binding them to a 6400 ton per year reduction. Considering additional reductions in automobile tailpipe emissions, the 6400 ton per year reduction will result in compliance with ambient standards in 1986.

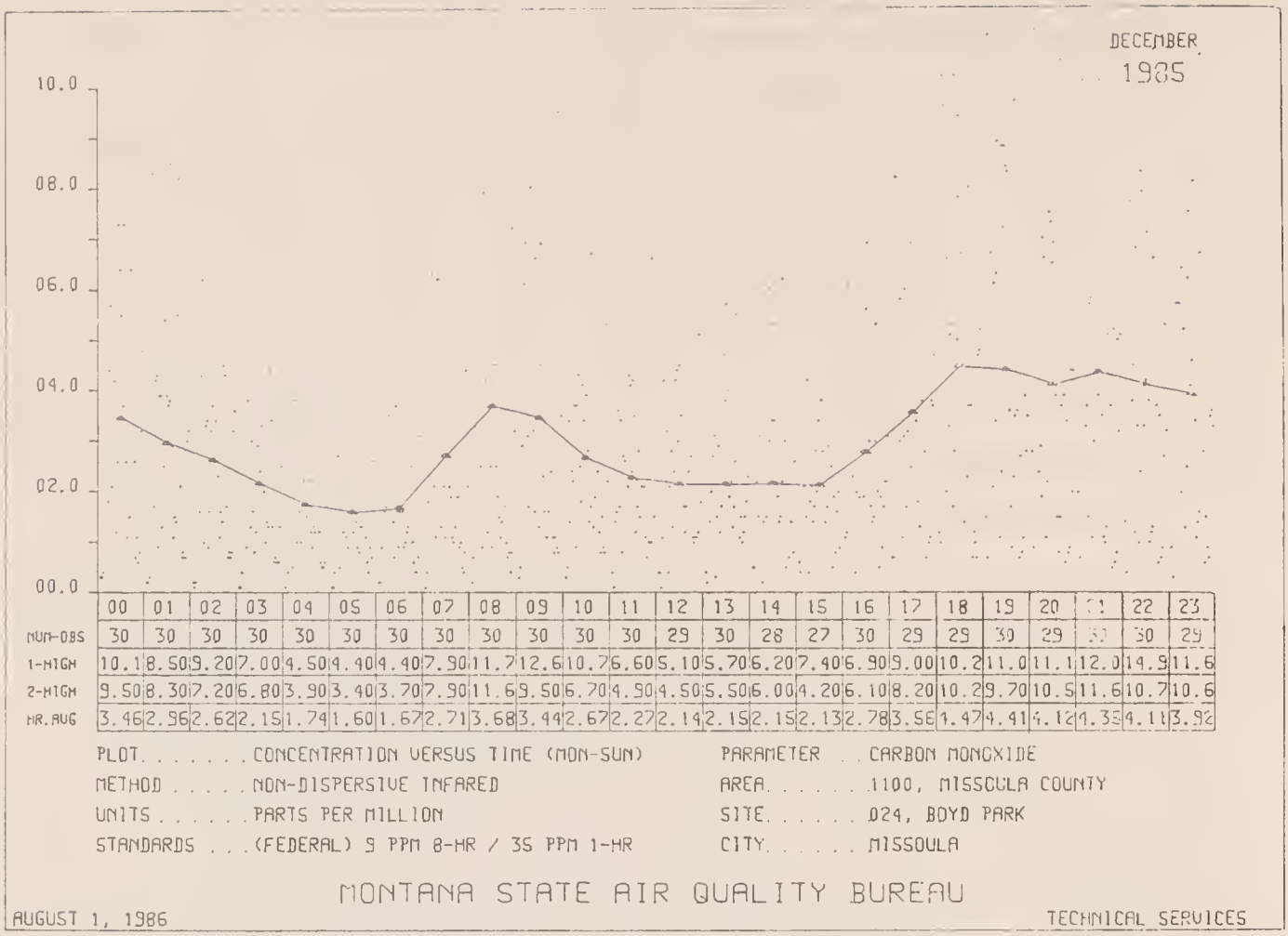
6. The department and Cascade County will continue to operate the Pardis Clinic site for at least one more year. If carbon monoxide concentrations remain in compliance with ambient standards for another year, the department will start developing a redesignation request for EPA to redesignate the area as attainment for carbon monoxide. Concurrent with the redesignation request, the department and Cascade County will reconsider the future of the site.

Missoula

1. Part of Missoula was designated nonattainment for carbon monoxide based on high concentrations recorded at the Malfunction Junction site. This site is located near the congested intersection of South Avenue, Russell Street, and U.S. 93. Violations of the 8-hour carbon monoxide standard have also been observed at Lions Park, along Higgins Avenue in the downtown area and at Boyd Park.

2. Figure 69 shows diurnal carbon monoxide concentrations for December, 1985, at the Boyd Park site. In the 1981 Network Review, the department suggested that inversion conditions during the winter have a greater effect on hourly carbon monoxide concentrations than traffic

FIGURE 69



	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NUM-OBS	30	30	30	30	30	30	30	30	30	30	30	30	29	30	28	27	30	29	29	30	29	30	30	29
1-HIGH	10.1	8.50	9.20	7.00	4.50	4.40	4.40	7.90	11.7	12.6	10.7	6.60	5.10	5.70	6.20	7.40	6.90	9.00	10.2	11.0	11.1	12.0	14.9	11.6
2-HIGH	9.50	8.30	7.20	6.80	3.90	3.40	3.70	7.90	11.6	9.50	6.70	4.90	4.50	5.50	6.00	4.20	6.10	8.20	10.2	9.70	10.5	11.6	10.7	10.6
HR.AVG	3.46	2.96	2.62	2.15	1.74	1.60	1.67	2.71	3.68	3.44	2.67	2.27	2.14	2.15	2.15	2.13	2.78	3.56	1.47	4.41	4.12	4.35	4.11	3.92

PLOT. . . . . CONCENTRATION VERSUS TIME (MON-SUN)
METHOD . . . . . NON-DISPERSIVE INFARED
UNITS . . . . . PARTS PER MILLION
STANDARDS . . . (FEDERAL) 9 PPM 8-HR / 35 PPM 1-HR

PARAMETER . . CARBON MONOXIDE
AREA. . . . . 1100, MISSOULA COUNTY
SITE. . . . . 024, BOYD PARK
CITY. . . . . MISSOULA

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volume and wood burning emissions. The data since 1981 seem to substantiate this hypothesis.

During November through February, Missoula is almost always experiencing poor ventilation. The ability of the airshed to disperse pollutants is limited to a relatively slow constant rate with some improvement during the middle of the day. The department speculates that during the day the emission rate from automobiles and wood burning is almost equal to the rate of dispersal with the exception of the 8:00 a.m.traffic peak. However, after about 3:00 p.m. the emission

rate definitely exceeds the dispersion rate and carbon monoxide levels start to climb. After midnight, when emissions are dropping rapidly, the rate of dispersal again exceeds the emissions and concentrations begin to decline.

3. Table 29 summarizes the carbon monoxide data for 1985 in Missoula. The Malfunction Junction SE site did not operate during 1985. The Boyd Park site recorded three exceedances of the 9 ppm eight-hour standard. One of the exceedances occurred in January and two occurred in December. The highest eight-hour average occurred on December 4 and 5 at 11.1 ppm.

4. The Missoula County Health Department temporarily shut down the Malfunction Junction carbon monoxide site in July, 1983. The site was reactivated in January, 1986, after the completion of the construction project at the intersection of Russell, South and Highway 93. The department and Missoula County consider the long-range operation of this site to be essential for several reasons: (1) the very high concentrations observed there; (2) the site's significance in regard to nonattainment designation and tracking; and (3) the large amount of historical data.

5. The Missoula County Health Department operates a carbon monoxide monitor at Boyd Park in the southern part of the city (see Figure 16). The site is located in a residential area which is almost entirely free of traffic influence. However, this part of the city has a very high use of wood for residential heating and recreation. The department and Missoula County are convinced that wood burning is the major cause of high carbon monoxide concentrations at this site. However, this

conclusion is somewhat undermined by the fact that typical 8:00 a.m. and 5:00 p.m. traffic peaks appear on the Boyd Park diurnal plot (Figure 69).

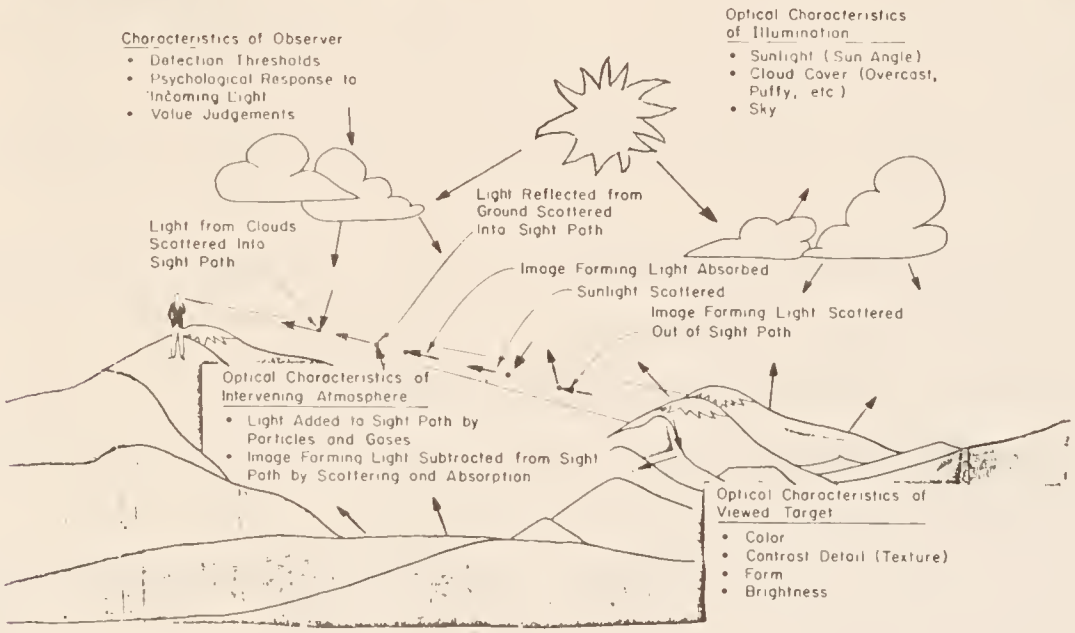
The department recommends that this site continue to be operated. To save money, Missoula County intends to run the site only during the winter. They suggest that high readings are nonexistent in the summer and that the CO standard is a short-term standard. If personnel become available, year-round monitoring will be resumed.

Proposed Sites

1. The department intends to establish a carbon monoxide monitoring site in Kalispell during 1986 provided a qualified operator can be located at a relatively low cost. The preferred location for the site is near the intersection of Highway 93 (main street) and Highway 2. This intersection is one of the busiest intersections in the state. In addition, a new major shopping mall is being built within two blocks of the intersection and the additional traffic will add to the carbon monoxide levels in the area.

2. If a qualified operator cannot be found, the department will install a carbon monoxide monitoring site in Helena. Three possible sites are under consideration: (1) Last Chance Gulch downtown, (2) the intersection of Montana Avenue, Helena Avenue and Lyndale, or (3) near the Prospect and Eleventh Avenues strip. The Last Chance Gulch location is characterized by moderate traffic and a valley and street canyon which restricts atmospheric dispersion. The other two locations both experience heavy traffic. The Prospect and Eleventh Avenues location is also influenced by a major shopping mall.

Visibility


Characteristics of Observer
• Detection Thresholds
• Psychological Response to Incoming Light
• Value Judgements
Optical Characteristics of Illumination
• Sunlight (Sun Angle)
• Cloud Cover (Overcast, Puffy, etc.)
• Sky
Light Reflected from Ground Scattered Into Sight Path
Light from Clouds Scattered Into Sight Path
Image Forming Light Absorbed
Sunlight Scattered
Image Forming Light Scattered Out of Sight Path
Optical Characteristics of Intervening Atmosphere
• Light Added to Sight Path by Particles and Gases
• Image Forming Light Subtracted from Sight Path by Scattering and Absorption
Optical Characteristics of Viewed Target
• Color
• Contrast Detail (Texture)
• Form
• Brightness

Federal regulations require Montana to protect visibility in Prevention of Significant Deterioration (PSD) Class I areas. The State of Montana also believes it has a responsibility to protect vistas throughout the state.

Visibility degradation is caused by the light scattering and absorbing effect of fine particulates and certain visible gases such as oxides of nitrogen. In Montana, visibility impairment is usually caused by fine particulates, since Montana does not have a large amount of heavy industry or automobile traffic.

In July, 1985, the Board of Health and Environmental Sciences adopted visibility regulations for new major stationary sources and approved

revisions to the Montana SIP which contained these regulations as well as a visibility monitoring plan. The monitoring plan calls for an annual review of the needs for visibility monitoring, analysis of existing data, and requirements for new facilities to supply monitoring data when their emissions may be expected to impact a Class I area.

The department has identified four major objectives of the monitoring plan:

1. To determine existing impairment, if any, in mandatory Class I areas and the sources of impairment;
2. To provide information for new source impact analyses;
3. To determine actual effects on visibility from the operation of new sources; and
4. To establish visibility trends in order to evaluate progress toward meeting the national goal of visibility protection.

The department will carry out the four objectives above by implementing the following program elements:

1. The department will address and consider the need for visibility monitoring as an integral part of its annual Network Review report. The Federal Land Managers (FLM) will be given an opportunity to comment on the annual Network Review before it becomes final.
2. In accordance with the results of the Network Review, the department will sponsor visibility stations and may enter into an agreement with the FLM to operate such stations by either party and to share data.
3. The department will request from each FLM responsible for any Class I area copies of any and all past or existing programs designed to monitor or evaluate visibility.

4. The department will request copies of all future visibility data gathered by each FLM on an annual basis, including any analysis and interpretation of such data.
5. The department will evaluate the data supplied by the FLM in addition to any other data collected by the department or any other appropriate source (such as proposed major stationary sources) on an annual basis.

In January, 1986, the AQB requested each FLM responsible for the administration of a Montana Class I area to submit visibility data and associated analysis as well as visibility monitoring recommendations to the department. The department received responses from Glacier National Park, Yellowstone National Park, the U. S. Fish and Wildlife Service, and the U. S. Forest Service. The department incorporated much of the FLM data and comments into this document.

Libby

1. The department operated a nephelometer at the River site near Libby during the fall of 1985. The sampler was operated as part of the fall Smoke Management Program. The Smoke Management Monitoring Team used the nephelometer data to quantify existing air quality and to determine if air quality was improving or degrading. The team used this information as one part of the decision-making process in regard to issuing open burning restrictions on slash burning.
2. The River site is located across the Kootenai River approximately 0.3 mile north of the central business district. The department's objective for monitoring at this location was to measure areawide visibility and not specifically the city of Libby. However, fine particulate emissions from the city and the Champion mill no doubt impact this site.

3. During 1985, the highest one-hour maximum of 69.2 x 10^{-5} per meter was recorded during an early morning temperature inversion on October 11, 1985. The reading occurred between 7:00 a.m. and 8:00 a.m., coinciding with the morning traffic peak and when people are restoking their wood stoves. Most of the high values during the fall occurred between 8:00 p.m. and 4:00 a.m. The mean back-scattering coefficient at the River site was 12.7 x 10^{-5}. This reading is substantially lower than the 18.1 x 10^{-5} recorded in 1984. Table 30 summarizes all of the back-scattering data.

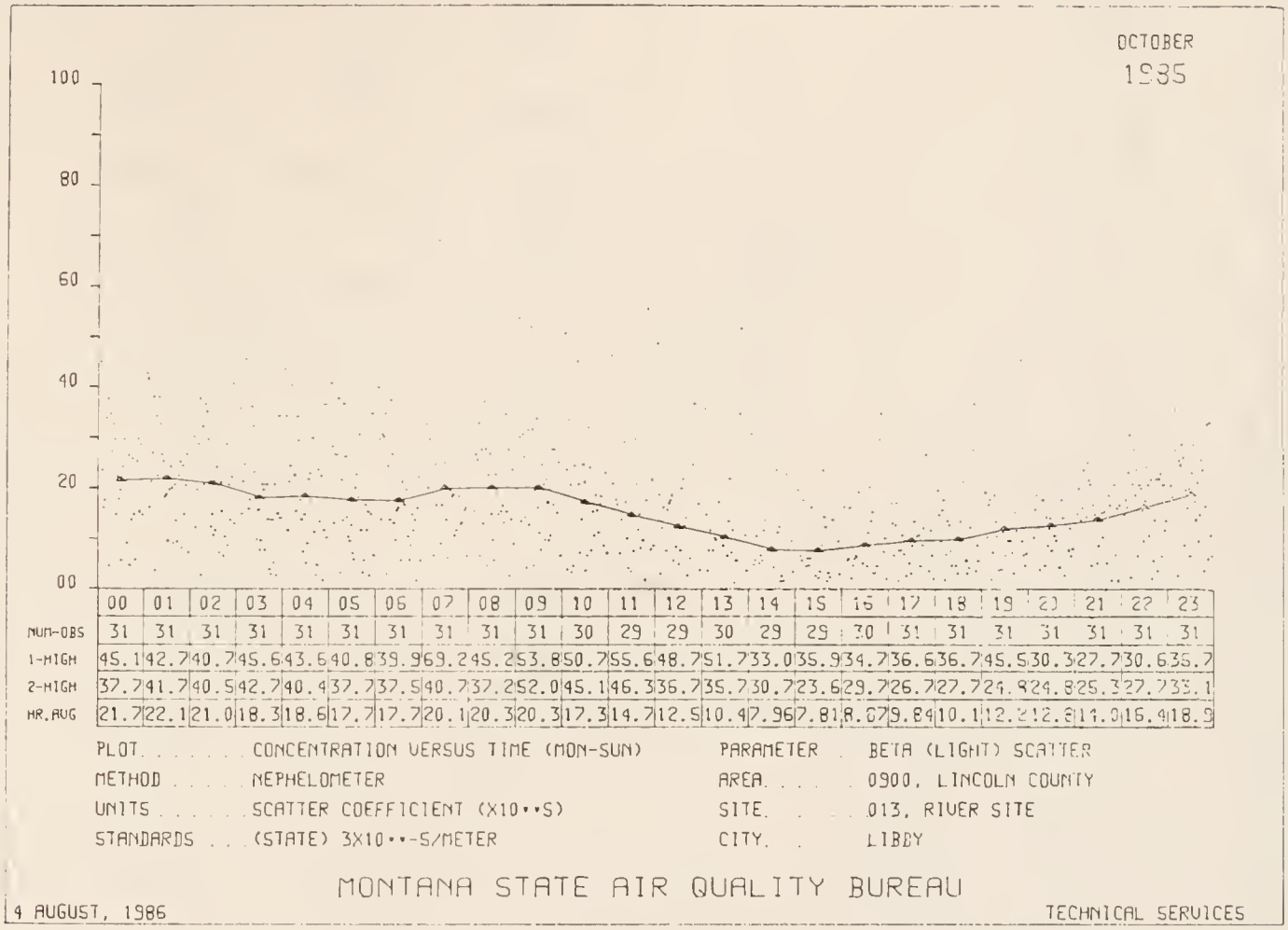
TABLE 30

SUMMARY OF 1984 AND 1985 BACK-SCATTERING DATA FROM THE RIVER SITE NEAR LIBBY

Year	Month	No. of Observations	1-hour Max.	24-hour Max.	Monthly Average
1984	Sep.	578	68.5	33.6	11.9
	Oct.	717	80.5	45.4	16.4
	Nov.	698	81.5	49.3	24.9
1985	Sep.	464	41.7	21.3	9.3
	Oct.	734	69.2	33.7	15.5
	Nov.	596	48.2	29.8	11.9

4. Figure 70 is a diurnal plot of back-scattering data from the River site. Although the best visibility occurs during mid-afternoon, there is very little hour-to-hour variation. The slight improvement during the afternoon is probably caused by the sun heating the earth's surface resulting in better surface mixing.

FIGURE 70



5. The department will continue to operate this site during the fall season. The site is extremely valuable to the Smoke Management Program.

Glacier National Park

1. Glacier National Park conducts a substantial visibility monitoring program within the park. The objectives of the program are: 1) to determine the impact of existing emission sources on visibility, and 2) to develop a visibility data base which can serve as a benchmark for the assessment of the impact from any proposed new sources.

2. Glacier's visibility monitoring program utilizes an automated teleradiometer, two automated cameras and a fine particulate monitor. The visibility monitoring network was substantially changed in June, 1985. A manual teleradiometer and camera located at the park superintendent's house at the West Lake District Office (see Figure 71) were replaced by automated systems and moved to the head of Lake McDonald northwest of the boathouse. The automated system is aimed at Teakettle Mountain which is located approximately 8 miles southwest of the park near the community of Columbia Falls. The automated teleradiometer takes one reading every 60 seconds and the readings are averaged every hour. The hourly averages are sent via satellite hookup and computer transmission to a firm in Fort Collins, Colorado, for analysis and storage.

The automated camera system consists of two cameras; one located at the head of Lake McDonald and aimed at Teakettle Mountain and the other located at the foot of Lake McDonald and aimed at the Garden Wall. The cameras are triggered by electronic timers and are equipped with self-winder attachments. Each camera takes a picture at 9:00 a.m., 12 noon and 3:00 p.m. daily. The exposed film is removed every 10 or 11 days and sent to Fort Collins, Colorado, for analysis and storage.

The fine particulate sampler is located at the fire weather station, about one mile from the park headquarters. The sampler separates the particles into coarse and fine fractions. Each sample is collected for three days, with twelve hours between samples to change filters. Each coarse and fine sample is analyzed for the concentrations of elements heavier than oxygen and for total mass. The elemental data is useful for determining the emission sources of visibility inhibiting fine particulates.

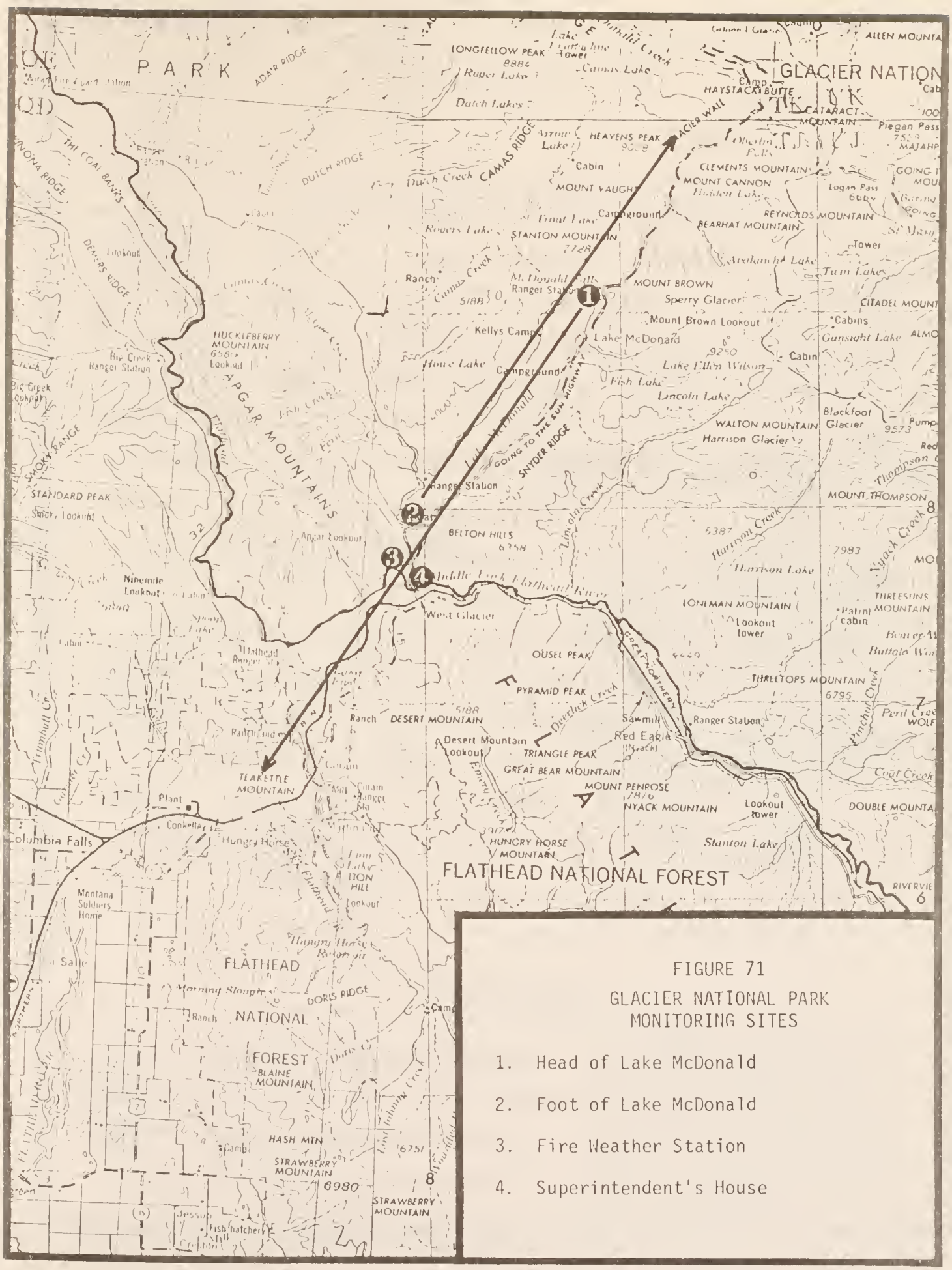


FIGURE 71

GLACIER NATIONAL PARK
MONITORING SITES

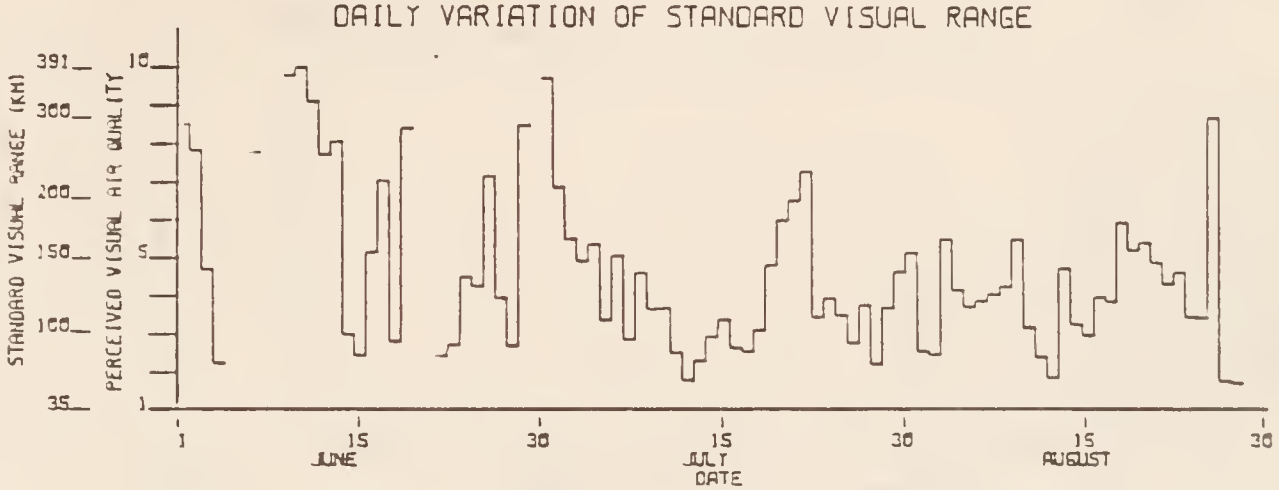
1. Head of Lake McDonald
2. Foot of Lake McDonald
3. Fire Weather Station
4. Superintendent's House

3. Figures 72, 73, 74 and 75 graphically display the seasonal results of the visibility monitoring conducted in Glacier National Park from June, 1984 to May, 1985. Since a complete set of data for 1985 was unavailable during the preparation of this report, the latest running year of data was considered. Data recovery over the period was poor despite an excellent effort (97% attendance) by the teleradiometer operator. The major reason for the poor data recovery was inclement weather (fog, rain, snow and low clouds) making any observation impossible.

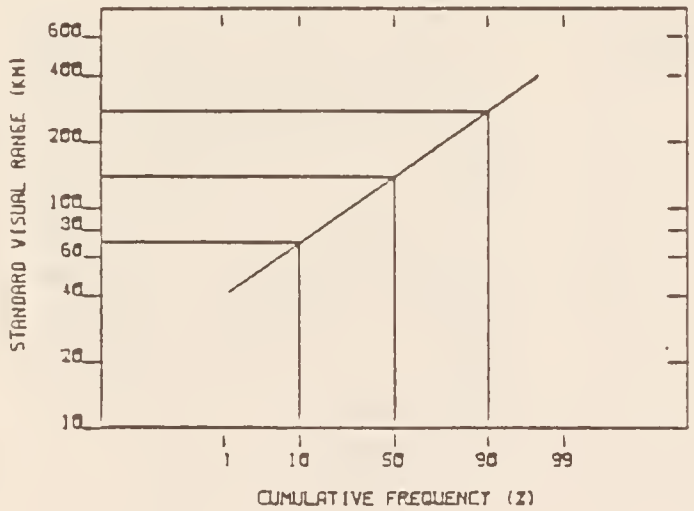
4. In light of the poor data recovery, it is difficult to draw conclusions from the data set. Although funding is limited within the National Park Service and unavailable at the department, the department believes it would be advantageous to supplement Glacier's visibility network with additional monitoring equipment which is less affected by inclement weather. Additional fine particulate monitors and/or nephelometers might be appropriate. Although these monitors can provide data under varying weather conditions, they collect point specific information and, in the case of the nephelometer, it requires a permanent shelter and a reliable power source. Normally, it requires several sites to adequately define visibility with point specific instruments, which is a major drawback considering the National Park Service's goal of maintaining the park in a near natural condition. The National Park Service is also interested in upgrading the visibility monitoring network within Glacier National Park through a joint project called IMPROVE (Interagency Monitoring of Protected Visual Environments) between the EPA and the Federal Land Managers. As part of the IMPROVE project, Glacier National Park intends to install a transmissometer and two additional particulate monitors.

SUMMER 1984 VISIBILITY REPORT FOR GLACIER NATIONAL PARK

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE DAILY GEOMETRIC MEAN STANDARD VISUAL RANGE (SVR) CALCULATED FROM TELERADIOMETER MEASUREMENTS MADE ON VALID TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	70
50	140
90	279

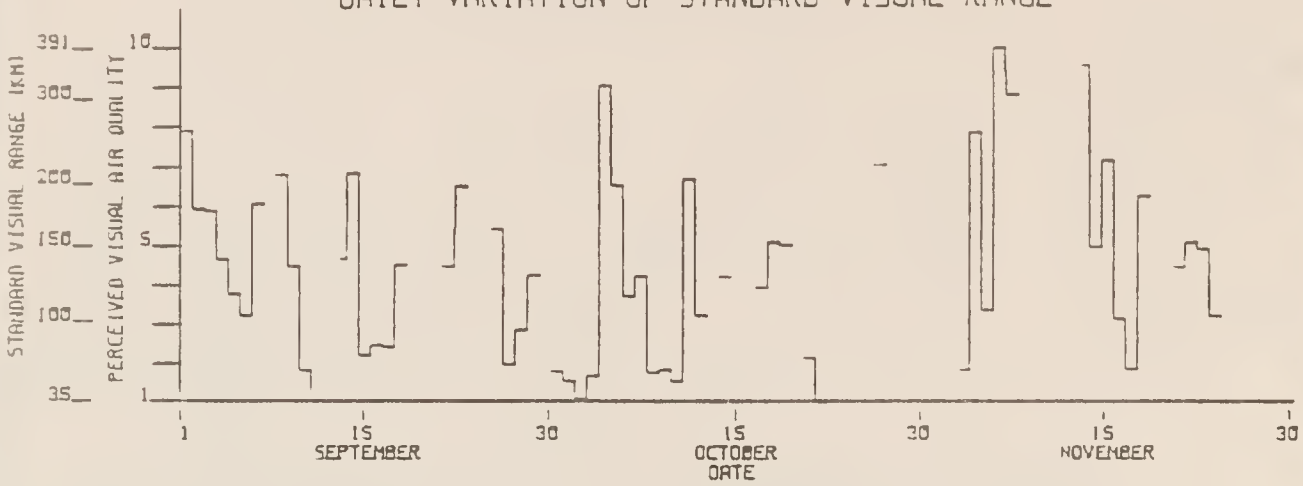
DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
SUMMER 84	99	38	276
SPRING 84	97	6	276
WINTER 84	96	0	66
FALL 83	63	20	273

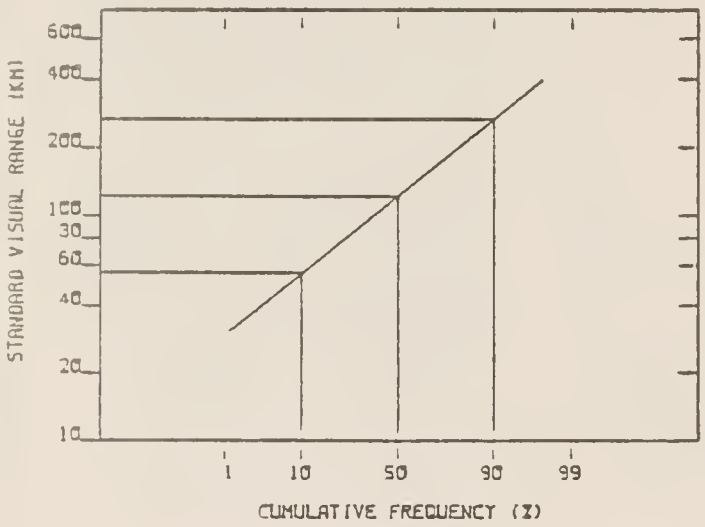
THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST OBSERVER RECOVERY VALUE THIS SEASON WAS 99% AT CANYONLANDS, BIG BEND AND GLACIER NATIONAL PARKS.

FALL 1984 VISIBILITY REPORT FOR GLACIER NATIONAL PARK

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE DAILY GEOMETRIC MEAN STANDARD VISUAL RANGE (SVR) CALCULATED FROM TELERADIOMETER MEASUREMENTS MADE ON VALID TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	56
50	123
90	269

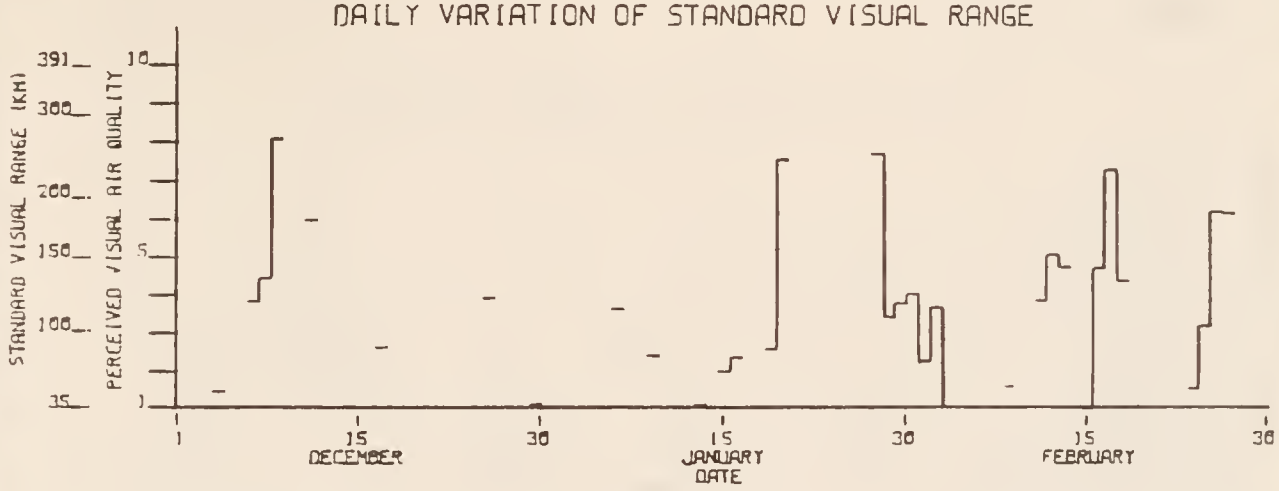
DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
FALL 84	100	39	273
SUMMER 84	99	30	276
SPRING 84	97	6	276
WINTER 84	96	0	66

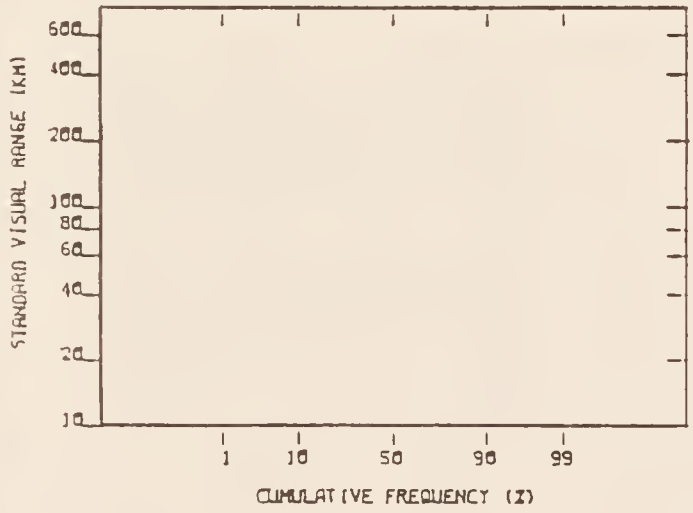
THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT GLACIER NATIONAL PARK.

WINTER 1985 VISIBILITY REPORT FOR GLACIER NATIONAL PARK

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE DAILY GEOMETRIC MEAN STANDARD VISUAL RANGE (SVR) CALCULATED FROM TELERADIOMETER MEASUREMENTS MADE ON VALID TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	9
50	9
90	9

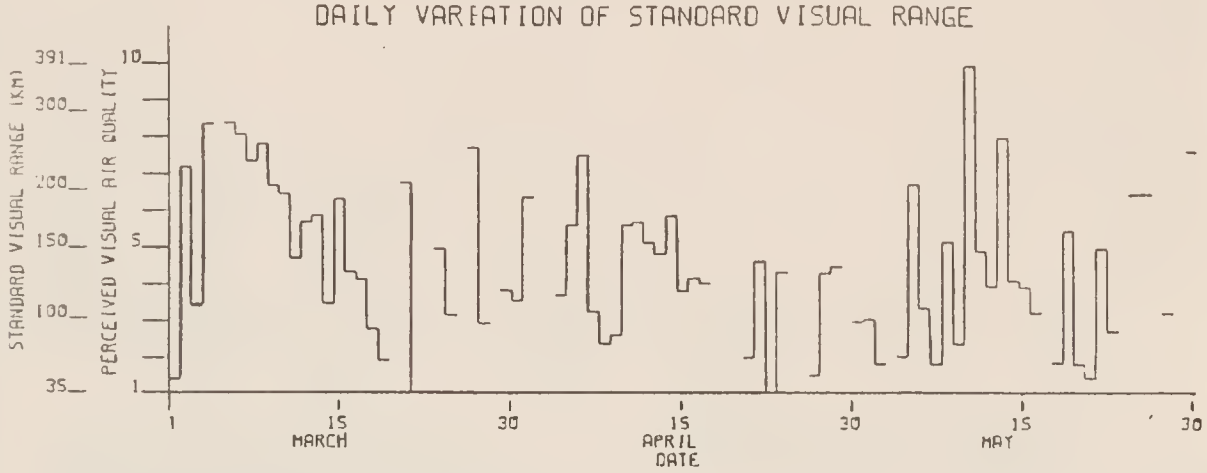
DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
WINTER 85	97	1	270
FALL 84	100	19	271
SUMMER 84	99	30	276
SPRING 84	97	6	276

THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO METEOROLOGICAL CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT BIG BEND NATIONAL PARK.

SPRING 1985 VISIBILITY REPORT FOR GLACIER NATIONAL PARK

DAILY VARIATION OF STANDARD VISUAL RANGE



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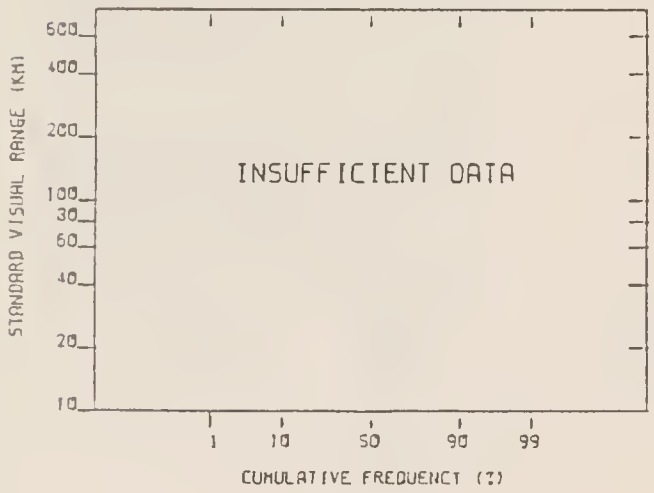


EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE DAILY GEOMETRIC MEAN STANDARD VISUAL RANGE (SVR) CALCULATED FROM TELERADIOMETER MEASUREMENTS MADE ON VALID TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	0
50	0
90	0

DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
SPRING 85	94	1	276
WINTER 85	97	1	270
FALL 84	100	39	273
SUMMER 84	99	80	276

THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT BIG BEND NATIONAL PARK.

Yellowstone National Park

1. Yellowstone National Park, in cooperation with the Homestake Mining Company, operated a visibility monitoring site at Mammoth Hot Springs from 6/25/81 through 6/29/82. The objective of the project was to establish a baseline of visibility data prior to the development of a gold mine at Jardine, Montana. The community of Jardine is located approximately three miles north of Yellowstone Park and seven miles from Mammoth Hot Springs.

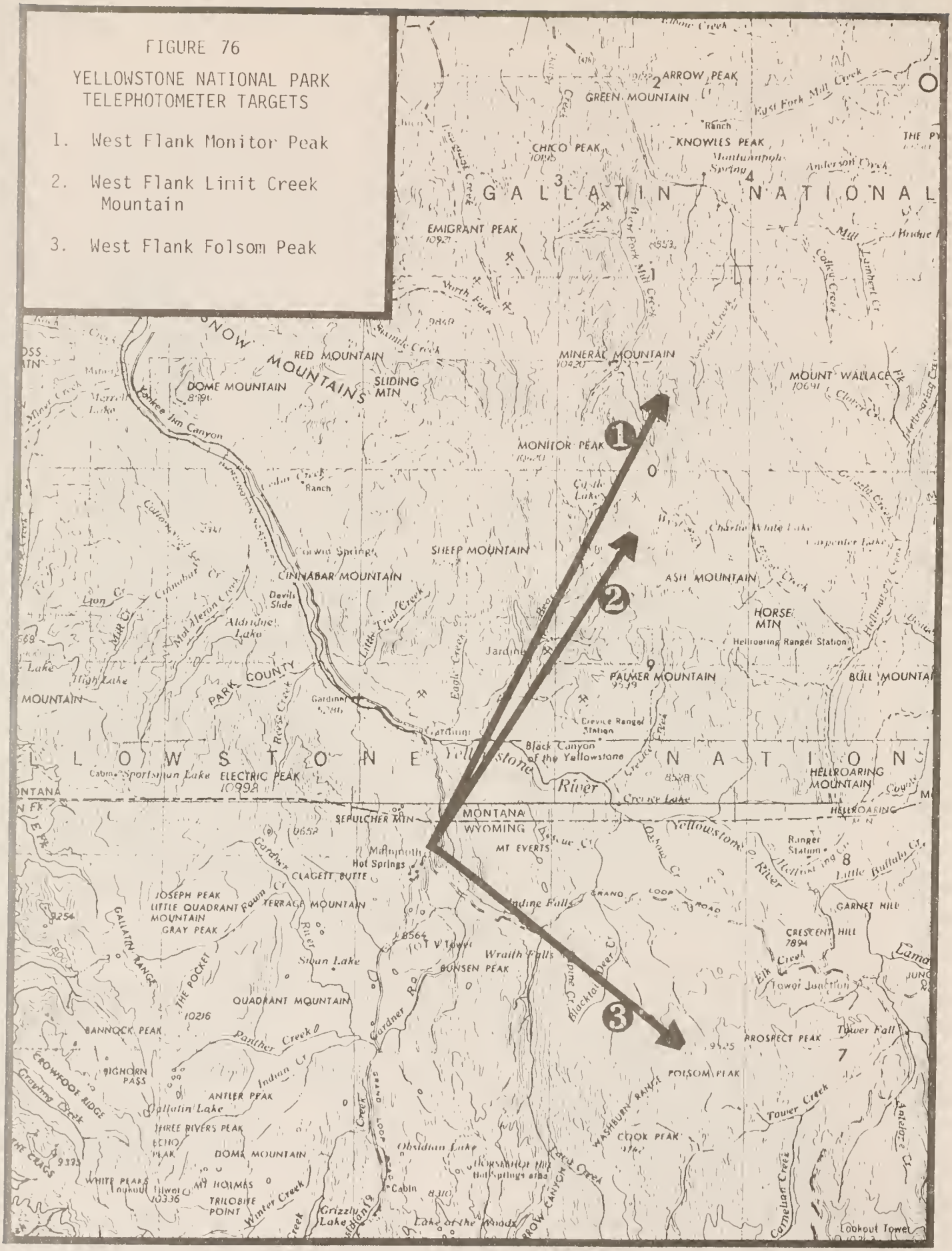
2. Yellowstone's visibility monitoring program consisted of a manually operated contrast telephotometer and 35 mm camera. The telephotometer and camera were sited in a balcony of the Park Service's Administration Building. Telephotometer readings and photographs were taken daily at 9:00 a.m., 12 noon and 3:00 p.m. During each observation period, the operator aimed the telephotometer at three different targets: 1) the west flank of Monitor Peak, 2) the west flank of Limit Creek Mountain, and 3) the north flank of Folsum Peak (see Figure 76). The first two targets are located outside of Yellowstone National Park in Montana. These targets lie approximately nine miles and four miles northeast of Jardine. The third target is in Yellowstone National Park approximately ten miles southeast of Mammoth Hot Springs.

3. Figures 77, 78, 79 and 80 graphically display the seasonal results of the visibility monitoring conducted in Yellowstone National Park from June 1, 1981 through May 30, 1982. Since this is the most recent visibility data available for Yellowstone, the department chose to include it in this report. Data recovery over the monitoring period was excellent during the summer, fair in the fall, and poor during the

FIGURE 76

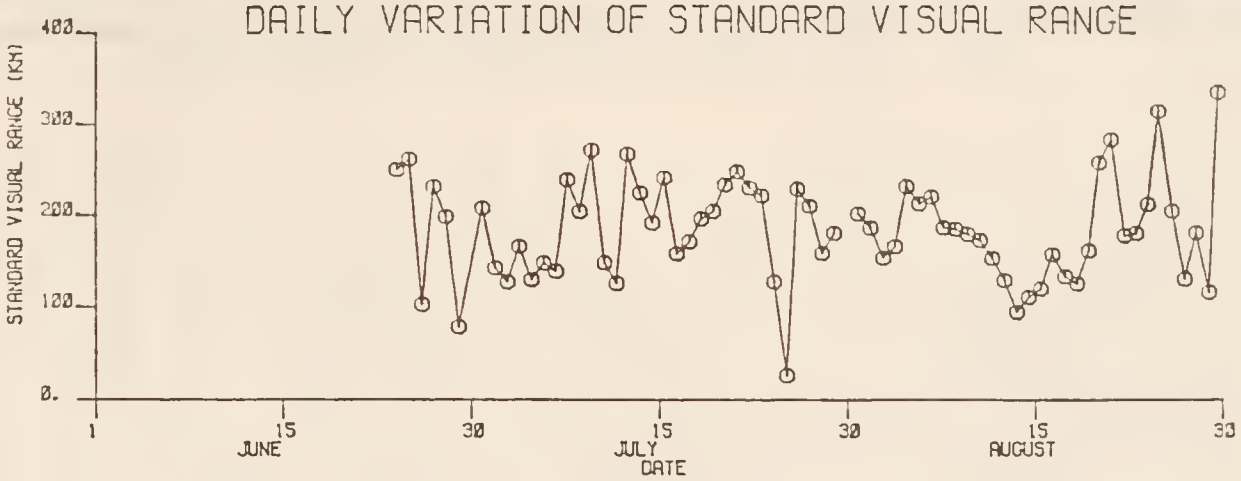
YELLOWSTONE NATIONAL PARK
TELEPHOTOMETER TARGETS

1. West Flank Monitor Peak
2. West Flank Linit Creek Mountain
3. West Flank Folsom Peak

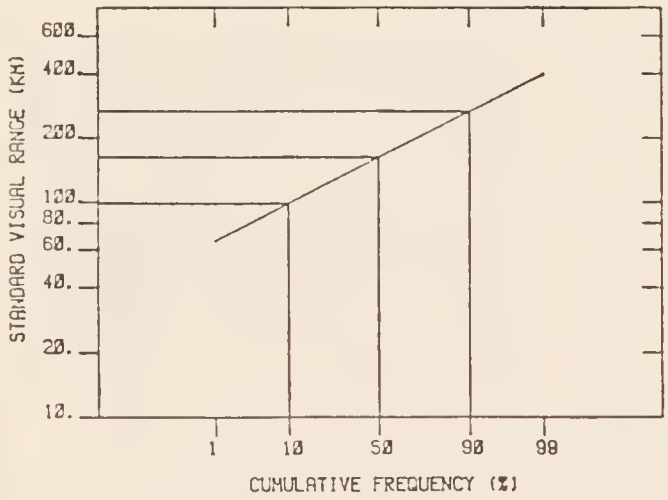


SUMMER 1981 REPORT FOR YELLOWSTONE NATIONAL PARK
FROM AIR QUALITY OFFICE, NPS
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY, EPA
AND VISIBILITY RESEARCH CENTER OF THE JOHN MUIR INSTITUTE

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH CIRCLE IN THE DAILY TIME PLOT ABOVE IS THE GEOMETRIC MEAN OF THE TELERADIOMETER MEASUREMENTS MADE ON VEGETATED TARGETS OURING THE DAY. ANY GAPS IN THE LINE REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

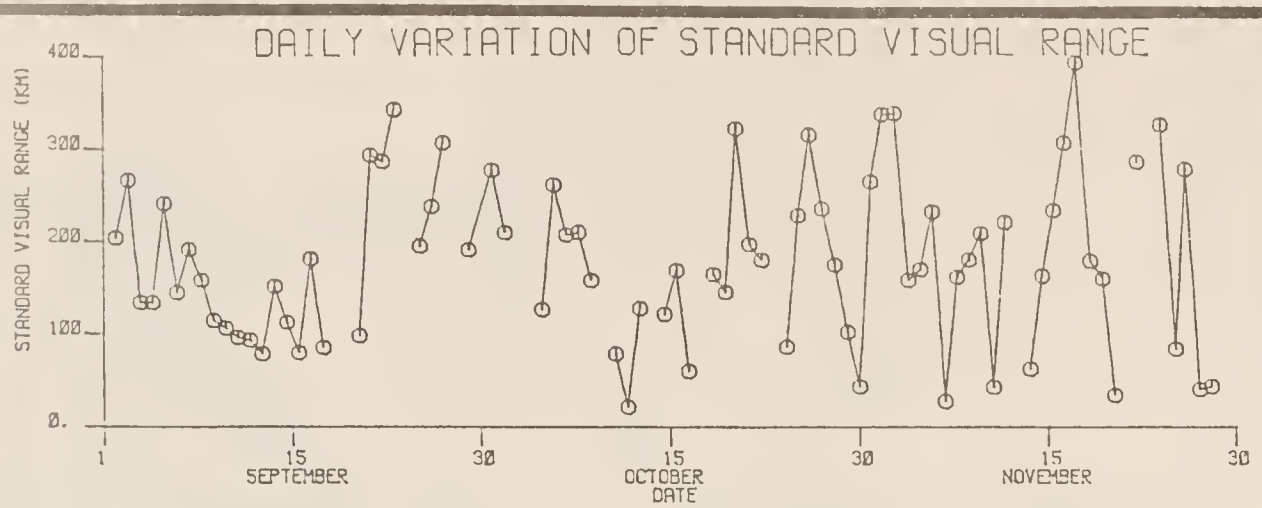
PERCENT	SVR (KM)
10.	99.
50.	163.
90.	267.

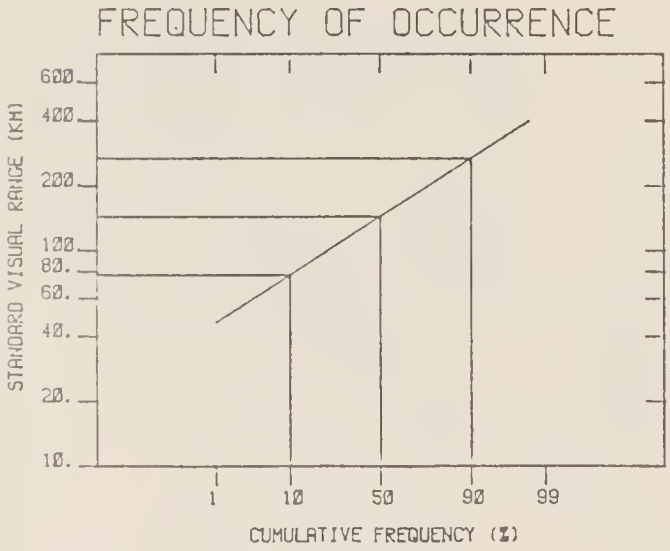
DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
SUMMER 81.	93.	87.	612.

THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHEREIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USEABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT BIG BEND, BRYCE CANYON, CANYONLANDS AND CAPITOL REEF.

FALL 1981 REPORT FOR YELLOWSTONE NATIONAL PARK
FROM AIR QUALITY OFFICE, NPS
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY, EPA
AND VISIBILITY RESEARCH CENTER OF THE JOHN MUIR INSTITUTE





EACH CIRCLE IN THE DAILY TIME PLOT ABOVE IS THE GEOMETRIC MEAN OF THE TELERADIOMETER MEASUREMENTS MADE ON VEGETATED TARGETS DURING THE DAY. ANY GAPS IN THE LINE REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10.	77.
50.	144.
90.	269.

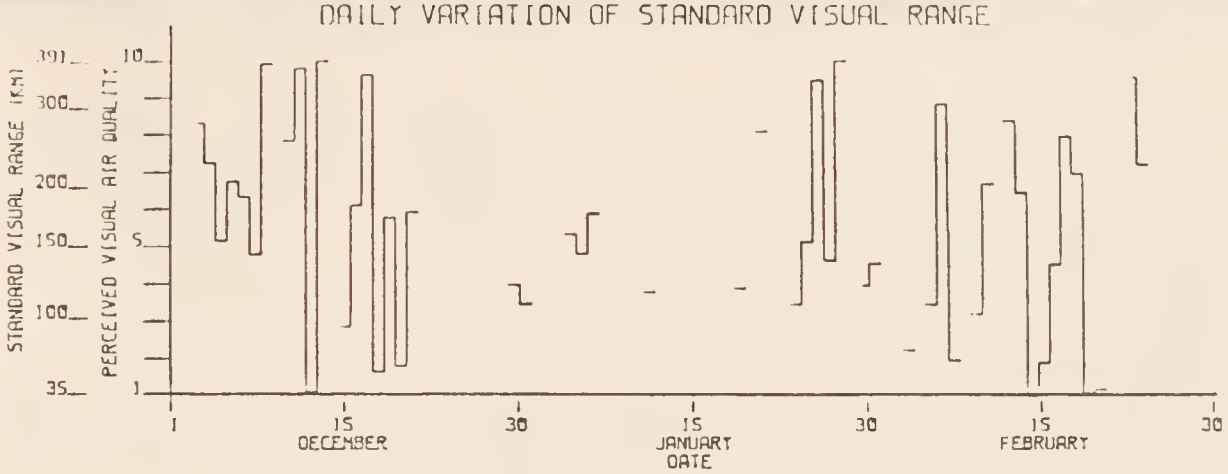
DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
FALL 81	88.	41.	919.
SUMMER 81	93.	97.	612.

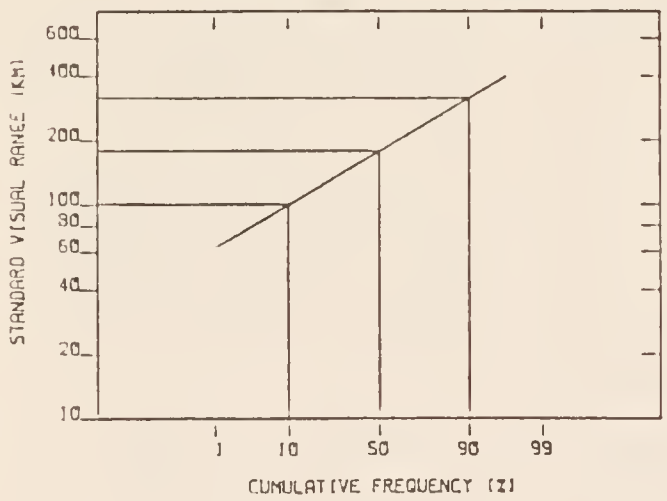
THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USEABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT GRAND TETON NATIONAL PARK.

WINTER 1982 REPORT FOR YELLOWSTONE NATIONAL PARK
FROM AIR QUALITY OFFICE, NPS
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY, EPA
AND VISIBILTY RESEARCH CENTER OF THE JOHN MUIR INSTITUTE

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE GEOMETRIC MEAN OF THE TELERADIOMETER MEASUREMENTS MADE ON VEGETATED TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	101
50	178
90	316

DATA RECOVERED

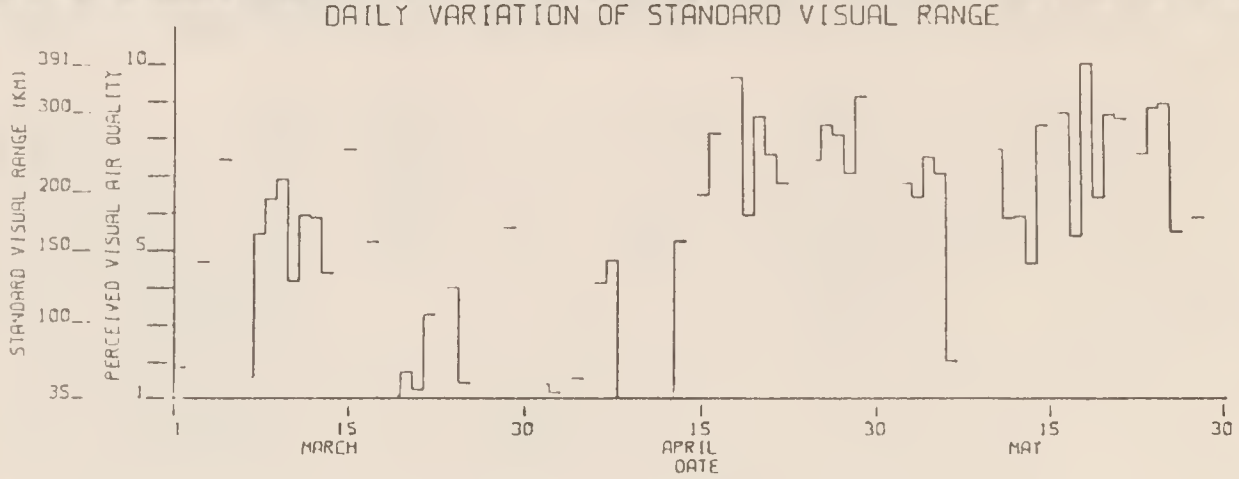
SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
WINTER 82	63	4	810
FALL 81	38	41	819
SUMMER 81	93	87	612

THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT CAPITOL REEF AND BIG BEND.

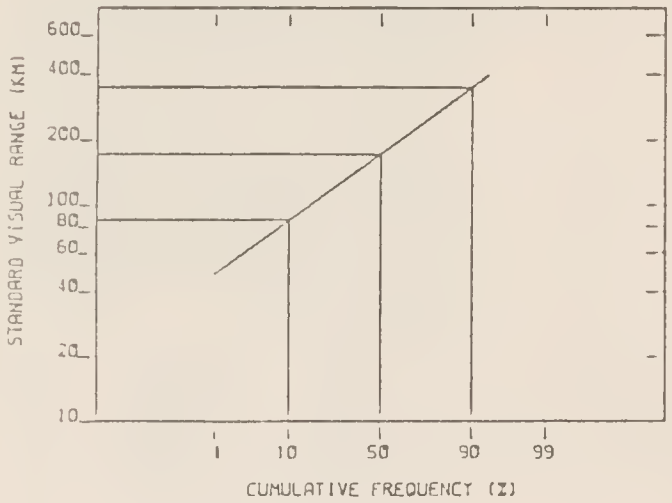
FIGURE 80

SPRING 1982 REPORT FOR YELLOWSTONE NATIONAL PARK
FROM AIR QUALITY OFFICE, NPS
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY, EPA
AND VISIBILTY RESEARCH CENTER OF THE JOHN MUIR INSTITUTE

DAILY VARIATION OF STANDARD VISUAL RANGE



FREQUENCY OF OCCURRENCE



EACH BAR IN THE DAILY TIME PLOT ABOVE IS THE GEOMETRIC MEAN OF THE TELERADIOMETER MEASUREMENTS MADE ON VEGETATED TARGETS DURING THE DAY. ANY GAPS IN THE GRAPH REPRESENT MISSING DATA.

FOR ANY POINT ON THE SLOPING LINE IN THE CUMULATIVE FREQUENCY OF OCCURRENCE PLOT TO THE LEFT, "X" PERCENT OF THE TIME THE STANDARD VISUAL RANGE (SVR) WAS "Y" OR LESS. THE SVR VALUES FOR THE 10, 50 AND 90% FREQUENCY OF OCCURRENCE ARE:

PERCENT	SVR (KM)
10	86
50	171
90	351

DATA RECOVERED

SEASON	OBSERVER(%)	SYSTEM(%)	POSSIBLE
SPRING 82	73	12	319
WINTER 82	63	4	810
FALL 81	38	41	319
SUMMER 81	93	37	612

THE "OBSERVER" DATA RECOVERY VALUE IS A MEASURE OF THE DILIGENCE OF THE FIELD PERSONNEL, DISCOUNTING MEASUREMENTS NOT MADE FOR REASONS RELATED TO ATMOSPHERIC CONDITIONS. THE "SYSTEM" DATA RECOVERY VALUE GIVES THE PERCENT OF ALL POSSIBLE MEASUREMENTS WHICH RESULT IN USABLE DATA. THE HIGHEST "OBSERVER" RECOVERY VALUE THIS SEASON WAS 100% AT GRAND TETONS.

winter and spring. As was the case in Glacier National Park, inclement weather conditions were responsible for the poor data recovery during the winter and spring.

4. The seasonal summary plots graphically show the difference between summer and winter data. Although the 50% occurrence levels remain fairly constant throughout, the 10% and 90% levels show increased variation in the winter. The effect of rapidly changing weather systems is the likely cause of the variations.

   The analysis was done utilizing data from all three targets, and in a manner consistent with the National Park Service visibility network. By using targets at a variety of azimuth angles and distances, a visibility baseline is obtained which is more representative of the overall region. This was done because a visual scan of the 641 slides taken throughout the year, many in fall and winter, showed no trapped hazes within the Jardine Basin. This was contrary to the presumptions made when establishing the site.

5. The poor data recovery obtained during the winter and spring seasons is consistent with the results obtained in Glacier National Park. Therefore, the department points out again the advantage of incorporating fine particulate monitors and/or nephelometers into any future visibility network.

   The department has issued an air quality permit for the Jardine Mine. One of the conditions contained in the permit is that the permittee will be required to perform visibility monitoring. The monitoring program will be conducted from Mammoth Hot Springs and will use the same equipment, targets, and procedures used in the baseline study.

The permittee will be required to monitor for at least two years; with one year during the construction phase and the other when normal mine production is achieved. A nephelometer is not required in the permit since baseline information is unavailable to compare future data with.

Other Federal Lands

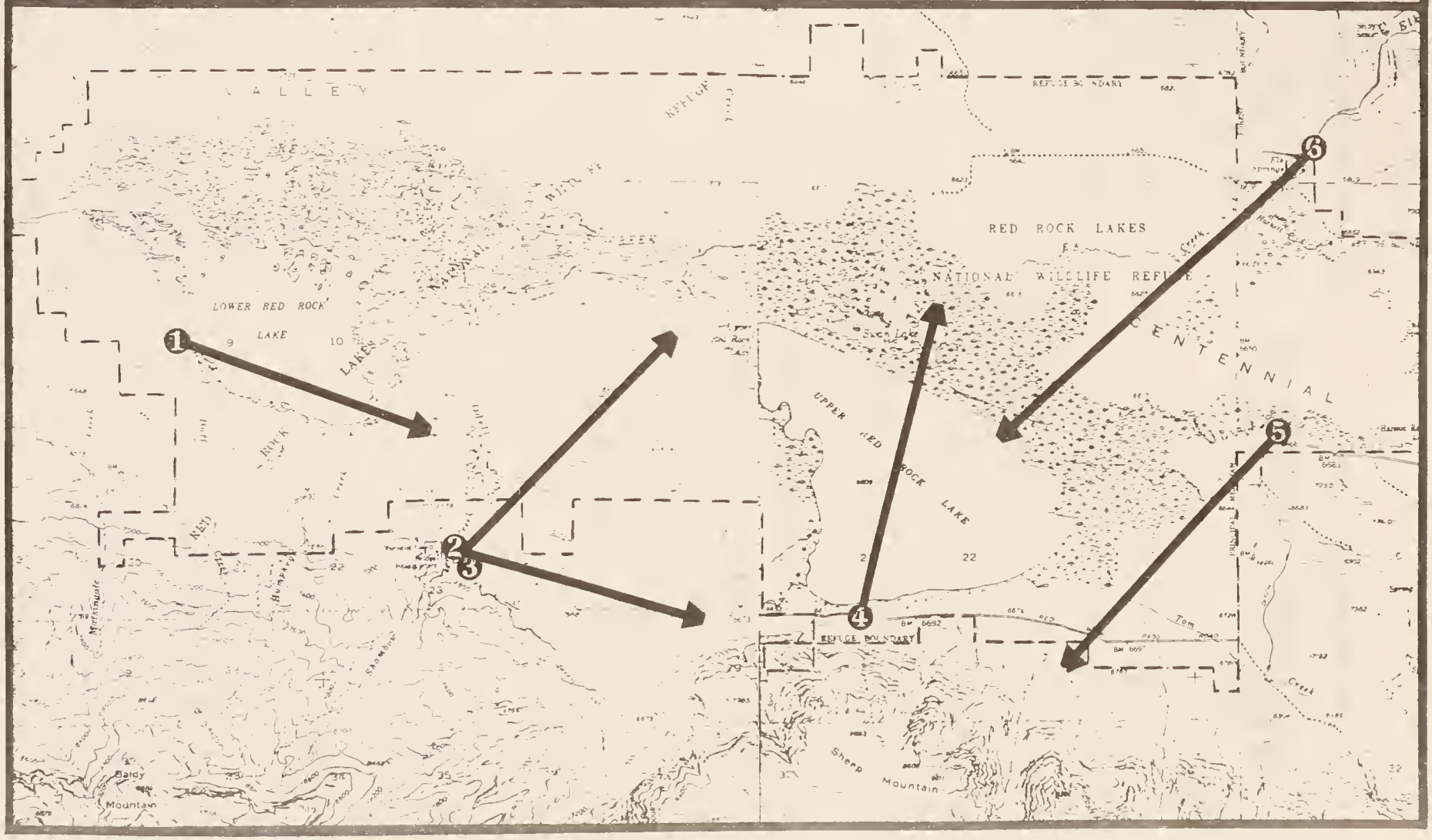
1. The department also received a written response from the U. S. Fish and Wildlife Service and a telephone response from Region 1 of the U. S. Forest Service. Neither agency has conducted any visibility monitoring within Montana and, therefore, did not submit any data.
2. The U. S. Fish and Wildlife Service did submit information describing six scenic views they have identified at the Red Rock Lakes National Wildlife Refuge (see Figure 81). They intend to perform visibility monitoring at some location within Montana at a future date. They also suggested that if the department initiates any visibility monitoring, we acquire new equipment consistent with that being used in the IMPROVE project.

Prospective Sites

1. The department purchased two used telephotometers during early 1985. The department would like to establish a visibility monitoring site near a Class I area. The site would be equipped with a telephotometer, nephelometer, fine particulate monitor, and acid deposition sampler.
2. The department is considering several different Class I areas. The Gates of the Mountains Wilderness area would be a very good location. Access to the edge of the wilderness is relatively good at the Beartooth Ranch, the boat landing area, and Nelson. In addition, the area is close to Helena (15-40 miles), so that it could be serviced quite easily.

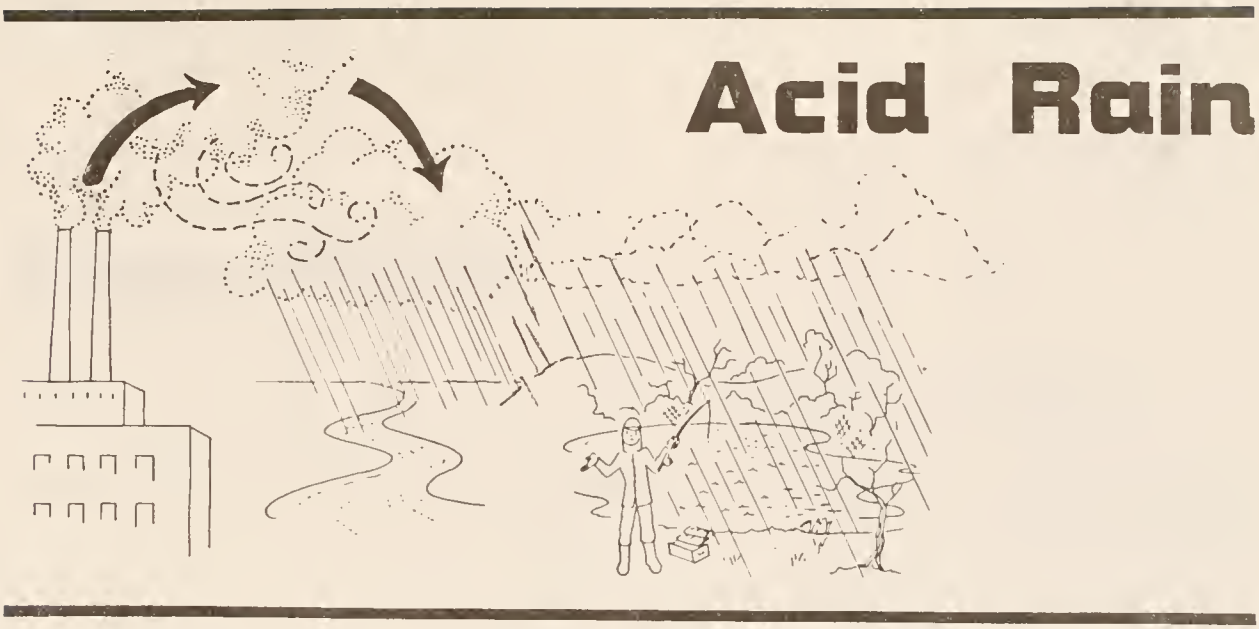
FIGURE 31
RED ROCK LAKE SCENIC VIEWS

1. View from Lower Campground to Sheep Mountain
2. View from Lakeside to Sheep Mountain
3. View from Lakeside to Gravelly Range
4. View from Upper Lake Campground to Gravelly Range
5. View from the Junction of the County Road and the Elk Lake Road to the Centennial Range
6. View from McDonald Pond to the Centennial Range



The U.S. Forest Service recommended the Anaconda Pintlar Wilderness and the Gates of the Mountains Wilderness as the two Class I areas most likely to be impacted by new industrial development. On the other hand, the Forest Service would like to see visibility monitoring conducted in or near the nation's premier wilderness, the Bob Marshall. The U. S. Fish and Wildlife Service suggested that the UL Bend and the Medicine Lake Wildlife Refuges would be their choices for visibility monitoring. The department intends to evaluate possible sites in or near each of these areas and, if funding is available, locate a site in the best area.

The department has insufficient funds to operate such a site on its own and, therefore, requested assistance in the form of money and personnel from the Federal Land Managers. The department does have the monitoring equipment and siting shelter to establish a site. Although the FLMs are interested in visibility monitoring, their budgets and personnel are already stretched to the limit. Therefore, the department will not take any action and will re-evaluate the financial situation in another year.



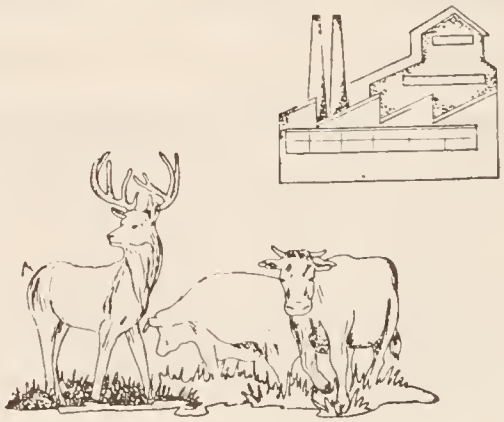
The department currently is not monitoring acid deposition. In early 1985, the department purchased five used acid deposition monitors. The samplers are capable of sampling both wet and dry deposition.

The Federal Land Managers who are in charge of many of the high elevation lakes and streams which are considered sensitive to acid deposition are extremely interested in expanding acid deposition monitoring. The department shares their interest, but is limited in the amount of monitoring it can do by budget restraints. However, the department proposes to operate one sampler at the proposed visibility site, provided FLM cooperation can be acquired in regard to sharing the cost of operating the site. The department will also loan samplers to any government entity willing to operate and maintain a sampler, as well as analyze the samples and summarize the data.

The department intends to locate its acid deposition sampler at the proposed visibility site for convenience and because the siting requirements for visibility monitoring and acid deposition monitoring can be met at one

location. The department is aware that acid deposition monitoring is currently being performed in Glacier National Park, Yellowstone National Park, near Ashland, Montana, near Helena, and on the Fort Peck Indian Reservation. The department will consider the geographic distribution of these monitoring sites when choosing a final visibility/acid deposition site. The department will also consider the buffering capacity of the soils in each area before making a final selection. Since personnel and financial assistance is not available from the FLMs at this time, the department will not establish a site but will re-evaluate the proposal during the 1987 Network Review.

Fluorides



During 1981, the Montana Board of Health and Environmental Sciences adopted new ambient standards for fluorides. The standards are based on the concentration of fluoride in forage. The standards were set at 50 ppm for a monthly average and 35 ppm for a grazing season average.

The department is auditing vegetation sampling conducted by the Stauffer Chemical Company and the Columbia Falls Aluminum plant to determine compliance. In addition, the department receives sample splits from both companies and occasionally analyzes them in the department's laboratory as a means of verifying the company data. During 1985, two monthly averages and the grazing season average at the Hilderman #6 site exceeded the Montana ambient standards for fluorides. All of the other sampling locations near the Stauffer Chemical Company and Columbia Falls Aluminum plant were in compliance with the standards or had insufficient data to determine compliance.

In an attempt to better define "grazing season", the department, in cooperation with Stauffer Chemical Company, contracted with the agricultural laboratories at Colorado State University and Montana State University to

analyze the vegetation for digestible energy. The initial analysis was performed utilizing an in vitro method to determine dry matter digestibility and subsequently, "digestible energy." The results indicated a significant difference between the two laboratories (Table 31). The in vitro results were not reproducible because of the dynamic nature of the rumen fluid extracted from the cow's stomach. The bacteria composition in the fluid differs between cows and also changes daily based on the cow's diet.

TABLE 31

IN VITRO DRY MATTER DIGESTIBILITY: A COMPARISON BETWEEN LABORATORIES

Plot	Date	MSU DMD	CSU DMD
Erickson #9	11-18-82	21.4	51.75
Hilderman #6	11-18-82	33.1	47.69
Tamietti #7	11-18-82	41.8	52.81
Hilderman #6	11-30-82	30.5	45.74
Tamietti #7	11-30-82	30.5	47.45
Erickson #9	11-30-82	32.8	-----

As an alternative method, the department and Stauffer Chemical Company used the "acid detergent fiber" method to indirectly determine the nutritive value of the forage samples. The Montana State University agricultural laboratory performed the acid detergent fiber analysis on all samples previously analyzed for "dry matter digestibility." Since digestible energy can be obtained from "dry matter digestibility" and not "acid detergent fiber," a predictive equation for dry matter digestibility based on acid detergent fiber was developed (see equation 1). The equation was derived from the Ramsay area samples (see Table 32).

TABLE 32

COMPARISON OF PERCENT DRY MATTER DIGESTIBILITY
WITH PERCENT ACID DETERGENT FIBER

Plot	Date	% DMD[a]	% ADF[b]
Erickson #9	11-18-82	51.75	52.0
Hilderman #6	11-18-82	47.69	44.8
Tamietti #7	11-18-82	52.81	43.9
Hilderman #6	11-30-82	45.74	45.0
Tamietti #7	11-30-82	47.45	49.0
Erickson #9	4-13-84	37.84	52.9
Hilderman #6	4-13-84	46.50	53.3
Erickson #9	5-11-84	44.74	52.4
Hilderman #6	5-11-84	56.91	40.9
Hilderman #6	5-22-84	68.50	32.5
Craddock #16	5-25-84	82.25	21.2
Peterson #15	5-25-84	74.16	23.5
Craddock #16	6-08-84	83.29	18.8
Peterson #15	6-08-84	81.02	23.1
Tamietti #7	6-08-84	61.80	23.3
Hilderman #6	6-08-84	64.96	26.4
Erickson #9	6-08-84	59.51	38.8
Hoffman[c]	5-09-84	75.56	26.2
Liddle	5-09-84	78.98	24.6
Doane	5-09-84	80.52	19.5
Hoffman	5-23-84	76.20	25.0
Liddle	5-23-84	73.39	26.7
Doane	5-23-84	73.42	23.7
Hoffman	6-07-84	79.86	21.9
Liddle	6-07-84	72.45	28.0
Doane	6-07-84	75.45	24.9
Hoffman	6-20-84	70.45	32.3
Liddle	6-20-84	65.47	31.8
Doane	6-20-84	62.48	32.5
ADF-1 winter forage		39.32	53.2
ADF-2 winter forage		47.04	47.0
ADF-3 straw		40.15	53.7
Hay control		62.46	34.33

[a] Analyzed by CSU nutrition lab.
[b] Analyzed by MSU agricultural lab.
[c] These plots were included to have data from forage of high nutritive value (Hoffman, Liddle and Doane), and of low nutritive value (ADF).

Equation #1 $DMD = 107.73 - 1.44 (\%ADF) + 0.00401 (\% ADF)^2$

$r^2 = 0.91$

Equation #2 DE = DMD x 4.4 Mcal/Kg x Kg/day of feed

This predictive tool allowed the department to determine the "dry matter digestibility" of any forage sample. Subsequently, by multiplying the "dry matter digestibility" of the forage sample by the calories per kilogram of "dry matter digestibility" and the average kilograms of feed intake (see equation 2), the department was able to establish the number of calories available to the animal and compare this value with recognized minimum requirements for weight maintenance in the specific type of animal.

A review of the Ramsay data indicated that, in general, the forage in the area has sufficient nutritional value to provide for maintenance on a year-round basis. However, snow cover and range management practices can restrict the availability of forage to a point where insufficient quantities are being consumed by an animal to allow for weight maintenance.

The department is considering the possibility of submitting a proposal to the Board of Health and Environmental Sciences which would incorporate these analytic and mathematical procedures into the Montana fluoride ambient air quality standards. The inclusion of the procedures would provide an objective means of defining "minimal nutritional needs" and "grazing season." If the Board of Health and Environmental Sciences were to adopt such a procedure, the department would be required to analyze all forage samples for "acid detergent fiber" as well as fluorides.

Prioritization Of Proposed Network Modifications

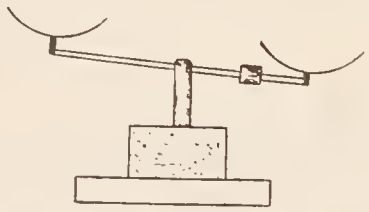


Table 33 presents a prioritized list of proposed modifications to the Montana ambient air monitoring network. The department prioritized this list based on the importance of the changes and the financial costs involved. It is the department's policy to operate the existing network correctly before initiating new projects; therefore, many quality assurance items are prioritized quite high.

The department will initiate the proposed modifications starting with item number 1 and proceeding through item number 51 as personnel and money are available. However, the first group of modifications will be completed before each subsequent group is started. Many of the items listed in Table 33 have already been completed and are identified accordingly.

TABLE 33

LIST OF PROPOSED MODIFICATIONS TO THE
MONTANA AMBIENT MONITORING NETWORK

*1. Establish a TSP and arsenic site at the Wolfe Residence in Anaconda.
*2. Establish a TSP and arsenic site at the Wheels and Deals car sales lot in Anaconda.
*3. Terminate TSP monitoring at the Powell County Courthosue in Deer Lodge.
*4. Terminate TSP and arsenic monitoring at the Lincoln School in Anaconda.
*5. Terminate TSP monitoring at the Beaverhead County Courthouse in Dillon.
*6. Terminate TSP and sulfation rate monitoring at the Circle 8 Guest Ranch near Choteau.
*7. Move the Lockwood Park trailer in Billings to a different location within the park.
*8. Terminate the Sidney sulfation rate network.
*9. Terminate lead analysis at the Montana City School.
*10. Shut down the North Johnson Lane site in Lockwood.
*11. Restart the Malfunction Junction carbon monoxide site in Missoula.
*12. Turn over all TSP monitoring duties in Lewis and Clark County to the county except the Cogwell Building and the East Helena sites.
*13. Transfer the responsibility for the Lockwood Park TSP monitor to Yellowstone County.

14. Establish a new sulfur dioxide site in Laurel.
15. Establish a new sulfur dioxide site at the Billings office.
16. Perform mutagen screening analysis on TSP filters from the Libby Courthouse, the Kalispell Universal Athletics, Butte Greeley School, and the Bozeman East Main sites.
17. Establish a TSP monitoring site in West Yellowstone.
18. Terminate TSP monitoring at the Sandstone School in Billings.
19. Initiate sulfur dioxide and TSP monitoring near Scobey.
20. Temporarily enlarge the Billings/Laurel/Lockwood sulfation rate network.

21. Re-initiate arsenic and cadmium analysis on the filters from the East Helena Firehall site.
22. Terminate collocated PM-10 monitoring at the Helena Cogswell Building.
23. Initiate collocated PM-10 monitoring at the Greeley School in Butte.
24. Initiate collocated TSP monitoring at the Junior High School site in Columbia Falls.
25. Terminate TSP monitoring at the Anders Residence in Columbia Falls.
26. Establish collocated TSP monitoring at the Capital Courts site in Helena.
27. Designate the Grand Avenue site as a NAMS site for TSP.

*Already accomplished.

28. Perform short-term monitoring of organic compounds in communities being impacted by wood stove and oil and gas emissions.
29. Initiate TSP monitoring in Whitefish.
30. Establish a carbon monoxide site in Kalispell or Helena.
31. Initiate TSP monitoring in Troy.
32. Initiate TSP monitoring in Superior.
33. Perform short-term formaldehyde sampling near plywood and particle-board plants.

34. Initiate every third day sampling for TSP at the Junior High School site in Columbia Falls.
35. Initiate every third day sampling for TSP at the Lincoln Electric Coop site in Eureka.
36. Initiate every third day sampling for TSP at the East Main City Building site in Bozeman.
37. Initiate every third day sampling for TSP at the Greeley School site in Butte.
38. Initiate every third day sampling for PM-10 at the Junior High School site in Columbia Falls.
39. Initiate PM-10 monitoring in Eureka.
40. Initiate TSP monitoring in southeast Great Falls.

41. Perform carbon dating of carbon monoxide in two western Montana cities or towns to distinguish wood stove emissions from fossil fuel emissions.
42. Initiate TSP monitoring in West Yellowstone.
43. Initiate TSP monitoring in Roundup.
44. Initiate TSP monitoring in Livingston.
45. Initiate TSP monitoring in the Helena valley.

46. Initiate every third day TSP monitoring at the Universal Athletics site in Kalispell upon the completion of the CMB study.
47. Initiate every third day PM-10 monitoring at the Universal Athletics site in Kalispell upon completion of the CMB study.
48. Initiate PM-10 monitoring at the Montana City School when additional equipment becomes available.
49. Initiate PM-10 monitoring at West Yellowstone when additional equipment becomes available.

50. Establish a visibility monitoring site near a Class I area.
51. Establish an acid rain monitoring site near a Class I area.

Rationale For Site Designation

The department's stations are designated either NAMS, SLAMS or SPM, depending on the general purpose of the station and the period of time it is expected to operate. Table 34 describes the distinction between each type of site.

In general, NAMS and SLAMS are intended to operate for long periods of time. Stations established for short-term measurements are normally designated SPM. If it is later decided to maintain the station beyond its originally projected closing date, the station could be redesignated SLAMS.

Table 35 lists the department's NAMS, SLAMS and SPM stations, their projected closing dates, and the reasons for their operation.

TABLE 34

MAJOR STATION DESCRIPTIONS AND COMPARISONS

Monitoring Station	SLAMS	NAMS	SPM
Purpose	General program monitoring for criteria pollutants. Supplies data for state implementation plan (SIP). Used for emergency episode monitoring.	Sets national policy, obtains long-term trend data, is used in special national studies, and is selected to monitor highest pollution areas which also have high population.	Special and short-term monitoring according to Montana needs. Monitors non-criteria pollutants.
Installation Deadline	January 1, 1983	January 1, 1981	None
Review Frequency	Annual	Every third year	Annual
Relocation Frequency	Relocated or changed only on annual basis if necessary and with EPA approval.	Not to be moved without prior EPA approval	No restrictions
Data Reporting	Beginning in 1981, annual reports due by July 1st of the following year to EPA Region and headquarters in N. Carolina.	Same	No reports due unless data is used for SIP purposes.
Report Requirements	Detailed summary, including violations of standards.	Same	None

TABLE 35

STATE OF MONTANA, AIR QUALITY BUREAU
AIR MONITORING NETWORK

Station		SAROAD Site I.D.	Monitoring Objectives	Spatial Scale	New Station to Open	Existing Station to Close
I. Total Suspended Particulates (TSP)						
A. National Air Monitoring Stations (NAMS)						
Billings	Grand Avenue	27 0080 072 G01	H,P	N		
Great Falls	Downtown	27 0660 017 G01	H,P	N		
	Downtown (collocated)	27 0660 017 G07	H,P	N		
B. State and Local Air Monitoring stations (SLAMS)						
Anaconda	Highway Junction	27 0400 004 F02	S	N		
Billings	Sandstone School	27 0080 067 G01	P	N		
	City Hall	27 0080 008 G01	H,P	N		12/86
	City Hall (coll)	27 0080 008 G07	H,P	N		12/86
	Lockwood Park	27 0080 065 G01	P,S	N		
Bozeman	East Main City Building	27 0120 002 F01	H,P	N		
Butte	Greeley School	27 0160 005 F01	H,P,S	N		
Columbia Falls	Anders Residence	27 0270 005 F01	H,P	N		12/86
	Junior High Sch.	27 0270 003 F01	H,P	N		
	Jr. High (coll)	27 0270 003 F07	H,P	N	12/86	
East Helena	Hadfield	27 0860 719 F02	H,P,S	N		
	Hadfield (coll)	27 0860 719 F07	H,P,S	N		
	Dartman Field	27 0860 724 F02	H,S	N		
	Firehall	27 0860 714 F02	H,P,S	N		

Eureka	Lincoln Elec. Coop	27 0940 005 F01	H,P	N	
Great Falls	Black Eagle P.O.	27 0660 019 G01	H,P,S	N	
	Fire Station	27 0660 009 G01	H,P	N	
Hamilton	Ravalli Co Crths.	27 1300 001 F01	H,P	N	
Helena	Cogswell Bldg.	27 0720 001 F01	P	N	
	Capital Courts	27 0720 013 G01	H,P	N	
	Cap.Courts (coll)	27 0720 013 G07	H,P	N	10/86
	Helena Valley		H,P	N	10/86
Kalispell	Universal Ath.	27 0800 015 F01	H,P	N	
Laurel	Junior High Sch.	27 0840 001 G02	P	N	
Libby	Courthouse Roof	27 0900 012 F01	H,P	N	
	Courthouse Roof (collocated)	27 0900 012 F07	H,P	N	
Missoula	Rose Park	27 1100 020 G01	H,P	N	
	Boyd Park	27 1100 024 G02	H,P	N	
	Env. Health Bldg.	27 1100 030 G01	H,P	N	
Montana City	School	27 0760 905 F01	H,P	N	
Ovando	Terry Smith Ranch	27 1260 024 F03	B	R	
Sidney	City Hall	27 1320 010 F01	H,P	N	
Thompson Falls	Sanders County Courthouse	27 1400 003 F05	H,P	N	

C. Special Purpose Monitors (SPM)

Anaconda	Wheels and Deals	27 0400 712 J02	S	M	6/86
	Wolfe Residence	27 0400 713 J02	S	M	6/86
Billings	Terry Park		H,P	N	6/86
	W. Billings/Com		H	N	6/86

Bozeman	Christie Field	27 0120 007 F01	H.P	N		
E. Missoula	Mount Jumbo Sch.	27 1100 033 G01	H,P	N		
Great Falls	Southeast		P	N	5/87	
Kalispell	Peterson School	27 0800 018 F05	P	N	8/86	
Livingston	City Center		H,P	N	8/87	
Missoula	Hoerner-Waldorf #1	27 1100 015 G02	S	N		
	H-W #1 coll.	27 1100 015 G07	S	N		
	H-W #2	27 1100 016 G02	S	N		
	Rattlesnake Sch.	27 1100 032 G01	H,P	N		
Roundup	City Center		H,P	N	8/87	
Scobey	Marlenee Ranch	27 0340 010 F05	B	R	9/86	6/87
Superior	Downtown		H,P	N	5/87	
Troy	Downtown		H,P	N	5/87	
West Yellowstone	City Center		H,P	N	6/87	
Whitefish	Downtown		H,P	N	5/87	

II. Particulate Matter Ten Micron (PM-10)

A. State and Local Air Monitoring Stations (SLAMS)

Billings	Grand Avenue	27 0080 072 G01	H,P	N		
Bozeman	E.Main City Bldg.	27 0120 002 F01	H,P	N		
Butte	Greeley School	27 0160 005 F01	H,P	N		
	Greeley S.(coll)	27 0160 005 F07	H,P	N	10/86	
Columbia Falls	Junior High Sch.	27 0270 003 F01	H,P	N		

Eureka	Lincoln Elec.Coop.	27 0940 005 F01	H,P	N	12/86
Great Falls	Downtown	27 0660 017 G01	H,P	N	
Hamilton	Ravalli Co.Cths.	27 1300 001 F01	H,P	N	
Helena	Cogswell Bldg.	27 0720 001 F01	H,P	N	
	Cogswell B.(coll)	27 0720 001 F07	H,P	N	10/86
	Phillips Lane	27 0860 009 F01	H,P	N	
Kalispell	Universal Athl.	27 0800 015 F01	H,P	N	
Libby	Lincoln Co.Cths.	27 0900 012 F01	H,P	N	
	Lincoln Co.Cths. (collocated)	27 0900 012 F07	H,P	N	
Missoula	Rose Park	27 1100 020 G01	H,P	N	
	Boyd Park	27 1100 024 G01	H,P	N	
	*Meadow Hills Sch.	27 1100 030 G01	P	N	
Ovando	Smith Ranch	27 1260 024 F03	B	R	
Thompson Falls	Sanders County Courthouse	27 1400 003 F01	H,P	N	

III. Lead (Pb)

A. State and Local Air Monitoring Stations (SLAMS)

East Helena	Hadfield	27 0860 719 F02	H,S,P	Mi
	Hadfield (coll)	27 0860 719 F07	H,S,P	Mi
	Dartman	27 0860 724 F02	H,S	N
	Firehall	27 0860 714 F02	H,S,P	Mi

*This site is equipped with a PM-15 size selective inlet.

IV. Sulfur Dioxide (SO2)

A. National Air Monitoring Stations (NAMS)

Billings	Lockwood Park	27 0080 065 F01	S,P	N		

B. State and Local Air Monitoring Stations (SLAMS)

Billings	Coburn Road	27 0080 066 F01	S	N		
	Air Quality Off.		P	N		
Laurel	East of Cenex		H,S	N		
Scobey	Marlenee Ranch	27 0340 010 F05	S	R	9/86	6/87

V. Carbon Monoxide (CO)

A. State and Local Air Monitoring Stations (SLAMS)

Great Falls	Pardis	27 0660 023 G02	H,P,S	M		
Missoula	Boyd Park	27 1100 024 G02	P	N		
	Malfunction Jct.	27 1080 005 F01	H,P,S	M		
	Southeast					

B. Special Purpose Monitors (SPM)

Kalispell or Helena	City Center		H,P	M	6/87	

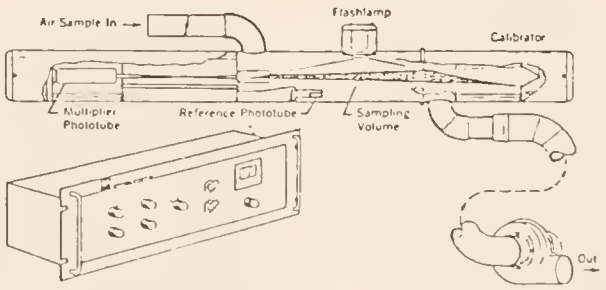
Monitoring Objectives:

H Highest Concentration
P Population
S Source
B Background

Spatial Scales:

Mi Micro
M Middle
N Neighborhood
U Urban
R Regional

Sampling Methods & Siting Criteria



The department uses EPA reference or equivalent methods for all air monitoring of criteria pollutants. For other pollutants, the department uses department-specified methods. Table 36 summarizes the various sampling methods used by the department.

The department also follows all federal requirements in regard to siting criteria. Table 37 summarizes the various siting requirements.

TABLE 36

SAMPLING AND ANALYSIS METHODS

Parameter	Sampling Method	Analysis Method
TSP	High Volume Method, 40 CFR, Part 50, App. B	Gravimetric
PM (2.5 and 15)	Dichotomous Virtual Impactor, Section 2.4.5 Montana Quality Assurance Manual, Sierra Instruments, Model 244	Gravimetric
	Beta Attenuation, Section 2.4.6 Montana Quality Assurance Manual, GCA Corporation, Aerosol Mass Monitor, Model APM	
	High Volume Method, 40 CFR, Part 50, App. B, High Volume Sampler with PM-15 Size Selective Inlet	Gravimetric
PM-10	Federal Register, March 20, 1984, 40 CFR, Part 50, 53, and 58, High Volume Sampler with PM-10 Size Selective Inlet	Gravimetric
	Beta Attenuation, Dasibi Model MPSI 100	
Lead	High Volume Method, 40 CFR, Part 50, App. B	Emission Spectra-ICAP
Trace Metals	High Volume Method, 40 CFR, Part 50, App. B	Emission Spectra-ICAP
Sulfates	High Volume Method, 40 CFR, Part 50, App. B	Colorimetric
Nitrates	High Volume Method, 40 CFR, Part 50, App. B	Reduction-Diazo Coupling
Sulfur Dioxide	EQSA-0276-009 "Thermo Electron Model 43 Pulse Fluorescent Sulfur Dioxide Analyzer"	
Carbon Monoxide	RFCA-0276-008 "Bendix Model 8501-5CA Infrared CO Analyzer"	

Parameter	Sampling Method	Analysis Method
Carbon Monoxide	RFCA-0381-051 "Dasibi Model 3003 Gas Filter Correlation CO Analyzer"	
Ozone	EQOA-0577-019 "Dasibi Model 1003-AH, 1003-PC, or 1003-RS Ozone Analyzers"	
Nitrogen Dioxide	RFNA-0677-021 "Monitor Labs Model 8440E Nitrogen Oxides Analyzer"	
Sulfation Rate	Method 42410-02-71T, Tentative Method of Analysis of the Sulfation Rate of the Atmosphere (Lead Plate Method), Methods of Air Sampling and Analysis, Second Edition	Turbidimetric
Visibility	Method 1120-03-76T, Tentative Method of Analysis for Suspended Particulate in the Atmosphere (Integrating Nephelometer) Methods of Air Sampling and Analysis, Second Edition, Meteorology Research, Inc., Model 1550B Contrast Telephotometry, Meteorology Research Inc., Vista Ranger, Model 3030	
Acid Deposition	ASTM Method ASTM STP 823, Sampling, Analysis, and Quality Assurance Protocols for National Atmosphere Deposition Program, Sampling and Analysis of Rain	Depends on what analyses are performed
Fluorides	Fluorides in Forage, ARM 16.8.813, Vegetation Sampling	Specific Ion Electrode

TABLE 37

SUMMARY OF PROBE SITING CRITERIA

Pollutant	Scale	Height Above Ground, Meters	Distance from Supporting Structure in Meters Vert.	Horiz.	Other Spacing Criteria
TSP	All	2-15	--	>2	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction. 2. Distance from sampler to obstacle must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby. 5. Must have minimum spacing from roads. This varies with height of monitor and spatial scale.
SO_2	All	3-15	>1	>1	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction. 2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. No furnace or incineration flues should be nearby.
CO	Micro	$3 \pm \frac{1}{2}$	>1	>1	1. Must be >10 meters from intersection and should be at a midblock location. 2. Must be 2-10 meters from edge of nearest traffic lane. 3. Must have unrestricted airflow 180° around the inlet probe.
CO	Middle and Neighborhood	3-15	>1	>1	1. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 2. Spacing from roads varies with traffic.
O_3	All	3-15	>1	>1	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction.

Pollutant	Scale	Height Above Ground, Meters	Distance from Supporting Structure in Meters Vert.	Horiz.	Other Spacing Criteria
					2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic.
NO_2	All	3-15	>1	>1	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction. 2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic.
Pb	Micro	2-7		>2	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction. 2. Distance from sampler to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler except for street canyon sites. 4. No furnace or incineration flues should be nearby. 5. Must be 5 to 15 meters from major roadway.
Pb	Middle, Neighborhood, Urban and Regional	2-15		>2	1. Should be >20 meters from the dripline and must be 10 meters from the dripline when the tree(s) act as an obstruction. 2. Distance from sampler to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby. 5. Spacing from roads varies with traffic.

Roadway average daily traffic vehicles per day	Separation distance between roadways and stations, meters: Micro Scale	Middle Scale	Neighborhood, Urban, Regional Scale
<10,000	5-15	>15-50	>50
20,000	5-15	>15-75	>75
>40,000	5-15	>15-100	>100

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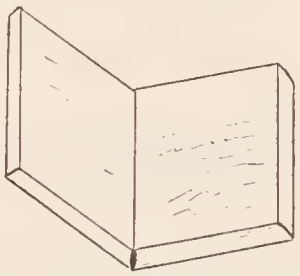

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